contact with hazardous material in soil [and/or groundwater] and/or (b) the restriction of certain activities occurring in, on, through, over or under the [Property][Portion of the Property].

NOW, THEREFORE, notice is hereby given that the use limitation set forth are as follows:

1. Permitted Activities and Uses Set Forth in the UL. The use limitation provides that a condition of No Significant Risk to health, safety, public welfare or the environment (such condition being defined in the Closure Plan) exists for any foreseeable period of time so long as any of the following activities and uses occur on the [Property][portion of the Property]:

1. ;
2. ; and
3. Such other uses which, in the Opinion of an owner or Registered Professional Engineer, shall present no greater risk of harm to health, safety, public welfare or the environment than the activities and uses set forth in this paragraph.

2. Uses Inconsistent with the notification. Uses which are inconsistent with the notification, and which, if implemented at the [Property][portion of the Property], may result in a significant risk of harm to health, safety, public welfare or the environment, are as follows:

1. ;
2. ; and
3. .

3. Obligations and Conditions Set Forth in the notification. If applicable, obligation and/or conditions to be undertaken and/or maintained at the [Property][portion of the Property] to maintain a condition of No Significant Risk as set forth in the notification shall include the following:

1. ;
2. ; and
3. .

4. Proposed Changes in Uses. Any proposed changes in activities and uses at the [Property][portion of the Property] which may result in higher levels of exposure to hazardous material than currently exist shall be evaluated by a Registered Professional Engineer or Department of Environmental Quality representative who shall render an opinion, in accordance with 9VAC20-60-580 and 9VAC20-60-800, of VHWMR, as to whether the proposed changes will present a significant risk of harm to health, safety, public welfare or the environment. Any and all requirements set forth in the notice to ensure a condition of No Significant Risk in the implementation of the proposed activity or use shall be satisfied before any such activity or use is commenced.

5. Violation of a Response Action Outcome. The activities, uses and/or exposures upon which this Notice is based shall not change at any time to cause a significant risk of harm to health, safety, public welfare, or the environment due to exposure to hazardous material without the prior evaluation of VDEQ, and without additional response actions, if necessary, to achieve or maintain a condition of No Significant Risk.

If the activities, uses, and/or exposures upon which this Notice is based change without the prior evaluation and additional response actions determined to be necessary by VDEQ in accordance with § 9VAC20-60-580 and 9VAC20-60-800, of the VHWMR, the owner or operator of the [Property][portion of the Property] subject to this Notice at the time that the activities, uses and/or exposures change, shall comply with the requirements set forth in with § 9VAC20-60-580 and 9VAC20-60-800, of VHWMR.

6. Incorporation into Deeds, Mortgages, Leases, and Instruments of Transfer This Notice shall be incorporated either in full or by reference into all deeds, easements, mortgages, leases, licenses, occupancy agreements or any other instrument of transfer, whereby an interest in and/or a right to use the Property or a portion thereof is conveyed.

Owner hereby authorizes and consents to the filing and recordation and/or registration of this Notice to become effective when executed and sealed by the undersigned P.E. and recorded and/or registered with the appropriate Registry(ies) of Deeds and/or Land Registration Office(s).

WITNESS the execution hereof under seal this _____ day of __________, 19__.

____

Owner

continued

COMMONWEALTH OF VIRGINIA

______________________,00   ____________________, 19___

Then personally appeared the above named ________________________ and acknowledged the foregoing to be _______________ free act and deed before me,

____

Notary Public

My Commission Expires:

The undersigned Professional Engineer hereby certifies that he/she executed the aforesaid Notice of Use Limitation and that in his/her opinion this Notice of Use Limitation is consistent with the Department of Environmental Quality performance standards for restricted use of site, and 9VAC20-60-580 and 9VAC20-60-800, of VHWMR.

Date: ____________________ ___________________________________

P.E.

[SEAL]

Appendix B

INDUSTRIAL SCENARIO RISK-BASED PROTOCOLS

1. Determination of Risk Based Action Levels for Soils and Subgrade Soils

Compliance with the closure performance standard will be verified by comparing the concentration of each constituent of concern (arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, tin, zinc, silver, and volatiles) in the soil samples to the risk-based cleanup goal. In order to determine action levels for all the determined hazardous constituents of concern (HCOC), a risk assessment will contain the following sections:

- site evaluation
- development of a site conceptual model
- identification of contaminants of concern
- identification of media and exposure pathways
- toxicity assessment
- calculation of the contaminant concentration at the point of exposure; and
- summary of health risks.

As part of identifying media and exposure pathways, the risk assessment report also will include use of the guidance referenced above in this Appendix to determine whether the industrial (adult) concentrations of the HCOC constitute a source to other media. If so, the affected media will be incorporated into the risk assessment.

As closure will be conducted on a surface impoundment area and excavated soils, groundwater monitoring and an associated demonstration of clean groundwater is not required in accordance with VHWMR § 9VAC20-60-580. It is assumed that any potential contamination is limited to soils only and, therefore, fate and transport mechanisms shall be used to evaluate impact from industrial contamination on groundwater. Prior to conducting a risk-based closure, representative <u>soil bulk density, cation exchange capacity (CEC), and other site specific parameters identified in the above referenced guidance document</u> must be measured to adequately reflect the physical and chemical soil properties at Lorton.

The risk goals will be a total cumulative hazard index of 1.0 for multiple noncarcinogens and a total cumulative carcinogenic risk of 10^{-04} for multiple carcinogens. However, risk from each individual carcinogen shall not exceed 10^{-06} (i.e., 1 case of cancer per 1,000,000 population).

The risk assessment will be conducted assuming an industrial (adult) exposure scenario. If the risk assessment demonstrates an unacceptable human health risk for industrial exposure, Lorton will contact the VDEQ for further guidance. The industrial scenario will require appropriate deed restrictions.

The initial step in the risk assessment will be to develop a site conceptual exposure model (SCEM) which depicts all potential exposure routes and media for the site and the receptors which may be exposed.

Once the SCEM is completed, the exposure assumptions outlined in the U.S. EPA guidance entitled, *"Risk Assessment Guidance for Superfund, Volume 1 - Human Health Evaluation Manual(Part A) and Development of Risk-Based Preliminary Remediation Goals (Part B)"*, will be employed to calculate health risks and cleanup criteria considering effects from multiple constituents and all routes of exposure. The cleanup goals will be developed in accordance with the guidance document noted above in this appendix. Information also will be taken as needed from U.S. EPA documents and databases (e.g., the Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Table (HEAST)). Details on the approach and assumptions used for each potential exposure pathway as provided below.

2. Exposure Assumptions

The exposure assumptions presented in the following sections are based on an adult receptor for an industrial scenario. Exposures for the adult receptors will be averaged on a time-weighted basis for the purposes of calculating human health risks, as called for in the above mentioned guidance document in this appendix. The exposure pathway for this receptor is ingestion of soil, dermal contact with soil, and inhalation of potentially contaminated soils. If the acceptable concentration for a chemical is below the lowest Practical Quantitative Limit (PQL) in the SW-846, the PQL shall be the cleanup performance standard.

3. Ingestion of Soil

The calculation of potential chemical intake from soil ingestion assumes that an adult employee will ingest 50 mg/day respectively of contaminated soil for 250 days/year.

4. Dermal Contact with Soil

The calculation of the potentially absorbed chemical dose by dermal contact with contaminated soil assumes that an adult at Lorton in the future will contact contaminated soil 250 days/year.

In order to estimate the amount of a particular constituent of concern (HCOC) which may potentially be absorbed through the skin, chemical-specific dermal absorption factors (ABS_{derm}) will be used.5. Inhalation of Soil

The calculation of potential chemical intake by inhalation of entrained soil particulates will assume that an adult at Lorton in the future will inhale elutriated contaminated soil for 250 days/year at an air inhalation rate of 20 m^3/day.

5. Toxicity Assessment
   a. Inhalation and Oral Reference Doses (RfD) and Slope Factors (SF)

      Slope factors (SF) pertinent to the oral and inhalation exposure pathways will be obtained from IRIS. If data are not available from IRIS, they will be obtained from HEAST.

   b. Dermal RfD and SF

      Chemical-specific oral-route absorption values (ABS_{oral}) will be used for the dermal exposure pathway.

   c. Risk Characterization for Carcinogens and Noncarcinogens

      For carcinogens, the cumulative potential risk can be calculated as follows:

$Risk_c = CDI_1 * SF_1 + CDI_2 * SF_2$ ..... $CDI_i * SF_i$

$Risk_c$ = target cumulative excess lifetime cancer risk

CDI_i = chronic daily intake (mg/kg body weight-day)

SF_i = carcinogenic slope factor (1/mg/kg-day) for the i^{th} toxicant

The cumulative potential risk posed by multiple noncarcinogens can be estimated using the hazard index approach:

$HI_c = CDI_1/Rf_1 = CDI_2/Rf_2$ ..... CDI_i/Rf_i

HI_c = hazard index or cumulative noncarcinogenic risk

CDI_i = chronic daily intake for the i^{th} toxicant (mg/kg-day)

Rf_i = reference for the i^{th} toxicant (mg/kg-day)

The most current values for calculating the chronic daily intake (CDI) and intake rates for evaluating carcinogenic risks will be provided by EPA guidance entitled, *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual Part A and Part B*, EPA/540/1-89/002, January 1989). CDI and noncarcinogen hazards will be calculated as described in the guidance referenced above in this appendix.

d. Ingestion of Contaminants in Soil

The chronic daily intake (CDI) associated with the ingestion of contaminants detected in soils is calculated using the following equation:

$$CDI = \frac{CS*IR*EF*ED}{BW*AT}$$

CS = chemical HCOC concentration in soil; TBD* (mg/kg)
IR = soil ingestion rate; 50 mg/day
EF = employee exposure frequency; 250 days/year
ED = employee exposure duration; 25 years
BW = adult body weight; 70 kg
AT = averaging exposure time; 70 years

e. Dermal Contact with Contaminants in Soil

CDI associated with dermal contact with contaminants detected in soils is calculated using the following equation:

$$CDI = \frac{CS*SA*AF*ABS*EF*ED}{BW*AT}$$

CS = chemical HCOC concentration in soil; TBD* (mg/kg)
EF = employee exposure frequency; 250 days/year
ED = employee exposure duration; 25 years
BW = adult body weight; 70 kg
AT = averaging exposure time; 70 years
SA = adult skin contact surface area; 4860 cm^2
AF = soil to skin adherence factor; 1.45 mg/ cm^2
ABS= dermal absorption factor

f. Inhalation of Contaminants

CDI associated with the inhalation of soil particulates suspended as an aerosol is calculated using the following equation:

$$CDI = \frac{CS*IR*EF*ED*(1/PEF+1/VF)}{BW*AT}$$

CS = chemical HCOC concentration in soil; TBD* (mg/kg)
IR = air inhalation rate; 20 m^3/day
PEF = particle emissions factor; 46.8 g/m^2-s per kg/m^3
VF = soil-to-air volatilization factor; 0 m^3/kg
EF = employee exposure frequency; 250 days/year
ED = employee exposure duration; 25 years
BW = adult body weight; 70 kg
AT = averaging exposure time; 70 years

RISK-BASED CLOSURE

1. Introduction

This document discusses the protocol for conducting a risk assessment to implement closure of hazardous waste management unit (HWMU) in accordance with Title 9 of the Virginia Administrative Code, Section 20-60-10 et seq. (Formerly the Virginia Hazardous Waste Management Regulations).

1. Risk-Based Evaluation In order to estimate the risk for chemicals of concern (COCs) a risk assessment will be conducted according to the Virginia DEQ document titled "Guidance for development of health based cleanup goals using decision tree/REAMS program (herein after "Virginia Risk Guidance") (November 1, 1994) prepared by Old Dominion University and the approved closure plan. The risk assessment report will contain the following sections:

- site evaluation,
- development of a site conceptual model,
- identification of contaminants of concern,
- identification of media and exposure pathways,
- toxicity assessment,
- estimation of contaminant concentration at the point of exposure, and
- summary of health risks.

The submission instructions contained in Appendix IX of the Virginia Risk Guidance will be reviewed prior to submitting the report to confirm that all necessary risk issues have been addressed. The risk goals/performance standards will be a hazard index of 1.0 for non-carcinogens and an individual carcinogenic risk of 1E-06 and cummulative carcinogenic risk of 1E-04.

Compliance with the closure standard will be verified by comparing the calculated individual and cumulative risk/hazard for all the contaminants of concern (COC) that failed background comparison to the risk-based performance standards.

The risk assessment will be conducted assuming a future residential/industrial use of the property. The methodology/equation for estimating the exposure concentration is presented in subsequent sections.

The initial step in the risk assessment will be to develop a site conceptual exposure model (SCEM) which depicts all potential exposure routes and media for the site and the receptors which may be exposed. The procedure for identification of contaminants of concern for health based is presented in section 2.... (from other section in the closure plan)

Once the SCEM is completed, the exposure assumptions outlined in the Virginia Risk Guidance will be employed to estimate the health risks and develop a cleanup criteria. Information will also be taken as needed from U.S. EPA documents and databases (e.g., the Risk Assessment Guidance for Superfund (RAGS), and the Integrated Risk Information System (IRIS)). The chemical intake equations and exposure parameter assumptions used to calculate estimate risks (obtained from Virginia risk assessment guidance/REAMS) are shown in Tables 1 through 4. Additional details on the approach and assumptions used for each potential exposure pathway are provided below.

As a part of the Risk Exposure and Analysis Modeling System (REAMS) evaluation, fate and transport modeling is necessary to demonstrate that the residual soil concentrations of contaminants of concern would not result in contamination of other environmental media of concern including the groundwater underneath the closure unit. For this purpose, representative soil sample(s) will be collected around the unit (subjected to closure) for analysis of the properties listed on page 62 of the REAMS document. [It is often less expensive to obtain this information from an agriculture lab rather than from an environmental lab]. In certain situations, groundwater sampling may be preferable.

2. Identification of Contaminants of Concern

Contaminants of concern includes those constituents detected during the closure soil and groundwater sampling which may be related to past waste management practices and whose concentrations statistically exceeded background levels. Please note that if the concentration of contaminants detected in the soil and groundwater did not exceed the background levels, no further risk-based evaluation will be required. Only those constituents of concern having concentrations that are statistically greater than background concentrations will be subject to REAMS evaluation to estimate the risks.

Also, for the purpose of evaluating the impact to groundwater, only those constituents which statistically exceeded the upgradient or background well concentration will be subjected to REAMS evaluation.

3. Exposure Assessment

The exposure assessment will identify transport mechanisms for the contaminants of concern that may potentially impact human receptors. The results of this assessment will be used to document the current and future exposure potential posed by the site.

With regard to soil, the following exposure assumptions will apply. Initially, a residential exposure will be assumed for the purpose of attempting to document unrestricted closure of the soil. If the risk for potential residential exposure does not exceed the performance standards, unrestricted closure of soil will be documented/accepted. If the site cannot be clean closed for residential use, then the option to pursue restricted closure (commercial/industrial) will be exercised. Closure to commercial/industrial scenario will requirement the facility to enact a deed restriction that eliminates the possibility of future residential use of the site. The requirements for establishing such a deed restriction are detailed in VDEQ□s Guidelines for Developing Health-Based Cleanup Goals Using Risk Assessment at A Hazardous Waste Site Facility for Restricted Industrial Use, dated June 1995. (A copy of this document is attached.)

Exposure routes will include ingestion, dermal absorption, and inhalation of vapors and dust particles.

With regard to groundwater, REAMS fate and transport modeling[2] will be required to assess residual soil contamination impacts to the groundwater. If the groundwater does not qualify for clean closure, the scope of future groundwater monitoring will be discussed with VDEQ. The groundwater exposure routes to be evaluated include ingestion, dermal absorption, and inhalation of volatiles emitted from the contaminated groundwater.

The exposure assumptions presented in the following sections are based on residential exposure. These constitute a reasonable maximum exposure scenario (RME), an exposure which is unlikely to occur but is reasonably possible. The exposure pathways for residential exposure include ingestion of soil, dermal contact with soil, inhalation of resuspended soil particulates, and inhalation of volatile organic compounds. Exposure to groundwater at the site is discussed in Section xxx.

3.1.1 Ingestion of Soil

The equation for potential chemical intake by soil ingestion for residential scenario on site is included in Table 1. This scenario also assumes that weather or other conditions (e.g., frozen ground/ snow /other cover) do not affect exposure and that all soil ingested is from contaminated areas of the site. These assumptions are protective of human health and the environment.

3.1.2 Dermal Contact with Soil

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[2] REAMS includes the unsaturated zone fate and transport model SESOIL. The purpose of running the model is two fold: a) determine whether the contaminants will reach the groundwater table in next 30 years. b) calculate the risk associated with the estimated concentration in the groundwater. For constituents with a promulgated MCL, the estimated concentration will be directly compared against the MCL. However, prior to running the SESOIL model the facility should obtain all the information identified on page 62, of the Virginia guidance document. The closure report must include evaluation of model results (concentrations reaching the groundwater) and a copy of SESOIL output file.

The equation for calculating the potential absorbed chemical dose by dermal contact with contaminated soil is provided in table 1. This scenario assumes that weather or other conditions (e.g., frozen ground/ snow or other cover) do not affect exposure, that contaminated soil remains on the skin long enough for the COCs to be absorbed and that all soil adhering to the skin is from contaminated areas of the site.

The skin surface areas (SA) used in the dermal pathway have been identified in REAMS guidance as 4,860 cm^2 for adults, which is the 50th percentile value for the arms, hands and lower legs (U.S. EPA, 1989b - See Attachment A).

A skin-soil adherence factor of 1.45 mg/cm^2 will be used in the dermal intake calculations. The U.S. EPA guidance for dermal exposure assessment (*Dermal Exposure Assessment: Principles and Applications*, EPA/600/8-91/011B) states that a range of values from 0.1 mg/cm^2 to 1.5 mg/cm^2 per event appear possible for dermal adherence factors (AF).

In order to estimate the amount of a particular COC which may potentially be absorbed through the skin, chemical-specific dermal absorption factors (ABS_{derm}) are used.

3.1.3 Inhalation of Resuspended Soil

The equation for potential chemical intake by inhalation of resuspended contaminated soil is included in Table 1. An inhalation rate of 0.83 m^3/hr will be used as specified in the Virginia Risk Guidance. This scenario assumes that the concentration of COCs in indoor dust will be equal to that in outdoor soil and that weather or other conditions, (e.g., frozen ground/snow or other cover) do not affect resuspension or exposure.

However, an appropriate model or equations in table-1, will be used to estimate the potential amount of respirable particulate matter generated by wind erosion. The estimated generation rate for eroded particulate matter will then be used derive an ambient air particulate concentration. Documentation for these models will be presented to the Department.

3.1.4 Inhalation of Volatilized COCs in Soil

Since the COCs have appreciable vapor pressures, they are expected to volatilize from soil. Inhalation of COCs as volatilized vapors is considered for this risk assessment. The equations in Table-1 will be considered for estimating the intake for this condition.

4. Toxicity Assessment

The two principle indices of toxicity used in risk assessment are the reference dose (RfD) and the cancer slope factor (SF). An RfD is the intake or dose per unit of body weight (mg/kg-day) that is unlikely to result in toxic (non-carcinogenic) effects to human populations, including sensitive subgroups (e.g., the very young or elderly). The RfD allows for the existence of a threshold dose below which no adverse effects occur.

The SF is used to express the cancer risk attributable to a discrete unit of intake; that is, the cancer risk per milligram ingested per kilogram of bodyweight per day ($[mg/kg\text{-}day]^{-1}$). The SF is an estimate of the upper-bound probability of an individual developing cancer as a result of exposure to a particular carcinogen. Unlike the RfD, the SF assumes that there is no threshold dose below which the probability of developing cancer is zero. Note that SFs are only developed for those chemicals which have been shown to be carcinogens in man or in at least several animal species. A carcinogenic weight of evidence rating is used to describe the strength of the experimental evidence for carcinogenicity. The U.S. EPA has developed SFs for most chemicals with weight of evidence ratings of "A" (known human carcinogen) or "B" (probable human carcinogen).

RfDs and SFs are derived by the U.S. EPA for the most toxic chemicals generally associated with chemical releases to the environment for which adequate toxicological data are available. If both the carcinogenic and non-carcinogenic effects of a particular compound are significant, both values may be established. However, in most cases only one value is available.

4.1 Inhalation and oral RfDs and SFs -

SFs pertinent to the oral and inhalation exposure pathways will be obtained from U.S. EPA's IRIS database. The IRIS (Integrated Risk Information System) on-line database was established by the U.S. EPA to provide risk assessors with peer reviewed toxicological data on chemicals commonly encountered at environmental sites of contamination. If data is not available from IRIS, it will be obtained from the Health Effects Assessment Summary Tables (HEAST), a compilation of toxicity values produced by the USEPA on a quarterly basis. The hierarchy presented in Appendix III of Virginia Risk guidance will be followed for using these sources.

4.2 Dermal RfDs and SFs -

Chemical specific oral-route absorption values (ABS_{oral}) are used to adjust the oral RfD or SF, which is computed from an administered dose, for use in the dermal exposure pathway. This correction is necessary due to the differences in absorption between the skin and the gastrointestinal tract. By correcting the administered-dose oral RfD or SF for the fraction expected to be absorbed in the gut, a dermal absorption factor can be used to estimate the correct dose received through the skin.

5. Evaluation of Risks

Using the toxicity criteria and identified exposure pathways discussed above, and the procedures described in the VDEQ guidance document (REAMS, November 1994), the risks presented by the COC will be estimated. The estimated risks will consider the effects from multiple constituents and all routes of exposure. The risk goals will be a total cumulative hazard index of 1.0 for multiple noncarcinogens and a total cumulative carcinogenic risk of 1E-04 for multiple carcinogens. However, the risk from each individual carcinogen shall not exceed 1E-06 (i.e., one case of cancer per 1,000,000 population).

5.1 Estimation of exposure concentration

For the contaminants detected at the site, an exposure point concentration (EPC) for each exposure pathway will be calculated for each contaminant by estimating the 95th upper confidence limit (UCL) on the arithmetic mean of the concentrations. If the calculated 95th UCL is greater than the maximum detected concentration, then the maximum detected concentration will be used as the EPC. The risks for contaminants will be calculated as per the equations and assumptions described in Table 1 through Table 4. If for a contaminant both carcinogenic and noncarcinogenic risk-based cleanup goal exists, the lower of the two will be used as a pathway specific to estimate the risk.

5.2. Risk Estimation

Health risk assessments are based on the relationship between risk, dose and toxicity:

$$Risk = Dose * Toxicity$$

Since dose is the product of the contaminant concentration multiplied by exposure (the intake), equation (1) becomes:

$$Risk = Intake\ rate * Contaminant\ conc. * Toxicity$$

(Please note that the term CDI in attached tables 1-4, includes intake rate and contaminant conc)

To estimate the intake, the exposure equations and assumptions discussed in Section 1, are used. The intake estimates for each route of exposure are then combined with the RfDs or SFs to determine the resulting risk.

For Carcinogens Risk:

$$Cancer\ Risk = (Intake_{oral} * Cont.\ conc. * SF_{oral})$$

$$+ (Intake_{inhal} * Cont.\ conc. * SF_{inhal}) + (Intake_{derm} * Cont.\ conc. * SF_{derm})$$

For Noncarcinogens:

$$Hazard\ Index = (Intake_{oral} * Cont.conc. * \frac{1}{RfD_{oral}}) + (Intake_{inhal} * Cont.conc. * \frac{1}{RfD_{inhal}})$$

$$+ (Intake_{derm} * Cont.conc. * \frac{1}{RfD_{derm}})$$

where, taking into account all COCs and relevant exposure pathways, the excess cancer risk is 10^{-6} or the hazard index is 1.0.

Using REAMS software a maximum acceptable contaminant concentrations will be calculated which meets the cumulative risk criteria. This process will be used in this risk assessment to derive the health-based cleanup criteria for the site. If the estimated risks satisfy the risk based performance standards, the soils/groundwater will be considered clean closed.

Appendix C

STATISICS
PART A: PERFORMANCE STANDARD: BACKGROUND
COCHRAN'S APPROXIMATION TO THE BEHRENS-FISHER STUDENT'S T-TEST

Using all the available performance standard data (n_B readings), calculate the background mean (X_B) and background variance (S_B^2). For the single monitoring well under investigation (n_m reading), calculate the monitoring mean (X_m) and monitoring variance (S_m^2).

For any set of data (X_1, $X_2 \ldots X_n$) the mean is calculated by:

$$\overline{X} = \frac{X_1 + X_2 + X_3 + \ldots X_n}{n}$$

and the variance is calculated by:

$$S^2 = \frac{(X_1 - \overline{X})^2 + (X_2 - \overline{X})^2 + \ldots (X_n - \overline{X})^2}{n-1}$$

where "n" denotes the number of observations in the set of data.

The t-test uses these data summary measures to calculate a t-statistic (t^*) and a comparison t-statistic (t_c). The t^* value is compare to the t_c value and a conclusion reached as to whether there has been a statistically significant change in any indicator parameter.

$$t^* = \frac{\overline{X_m} - \overline{X_B}}{\left| \frac{S_m^2}{n_m} + \frac{S_B^2}{n_B} \right|^{1/2}}$$

The t-statistic for all parameters except pH and similar monitoring parameters is:
If the value of this t-statistic is negative then there is no significant difference between the monitoring data and background data. It should be noted that significantly small negative values may be indicative of a failure of the assumption made for test validity or errors have been made in collecting the background data.

The t-statistic (t_c), against which t^* will be compared, necessitates finding t_B and t_m standard (one-tailored) tables where, t_B = t-tables with (n_B-1) degrees of freedom, at the 0.05 level of significance.

t_m = t-tables with (n_m-1) degrees of freedom, at the 0.05 level of significance.

Finally, the special weightings W_B and W_m are defined as:

$$W_m = \frac{s_m^2}{n_m}$$

$$W_B = \frac{s_B^2}{n_B}$$

and so the comparison t-statistic is:

$$t_c = \frac{W_B t_B + W_m t_m}{W_B + W_m}$$

The t-statistic (t^*) is now compared with the comparison t-statistical (t_c) using the following decision rule: If t^* is equal to or larger than t_c then include that are most likely has been a significant increase in this specific parameter. If t^* is less than t_c then conclude that there most likely there has been a change in this specific parameter.

The t-statistic for testing pH and similar monitoring parameters is constructed in the same manner as previously described except the negative sign (if any) is discarded and the caveat concerning the negative value is ignored. The standard (two-tailed) tables are used in the construction t_c for pH and similar monitoring parameters.

If t^* equal to or larger than t_c, then conclude that there most likely has been a significant increase (if the initial t^* had been negative, this would imply a significant decrease). If t^* is less than t_c, then conclude that there most likely has been no change.

A further discussion of the test may be found in Statistical methods (6th Edition, Section 4.14) by G.W. Snedecor and W.G. Cochran, or Principles and Procedures of Statistics (1st Edition, Section 5.8) by R.G.D. Steel and J.H. Torrie.

Table 1
Standard t-Tables

0.05 Level of Significance

Degrees of Freedom	t-values (one tail)	t-values (two tail)
1	6.314	12.706
2	2.920	4.303
3	2.353	3.182
4	2.132	2.776
5	2.015	2.571
6	1.943	2.447
7	1.895	2.365
8	1.860	2.306
9	1.833	2.262
10	1.812	2.228
11	1.796	2.201
12	1.782	2.179
13	1.771	2.160
14	1.761	2.145
15	1.753	2.131
16	1.746	2.120
17	1.740	2.110
18	1.734	2.101
19	1.729	2.093
20	1.725	2.086
21	1.721	2.080
22	1.717	2.074
23	1.714	2.069
24	1.711	2.064
25	1.708	2.060
30	1.697	2.042
40	1.684	2.021

Adopted from Table III of "Statistical Tables for Biological, Agricultural, and Medical Research" (1974, R. A. Fisher and F. Yates).

The t-statistic for pH and similar monitoring constituents/parameters is constructed in the same manner as previously described except the negative sign (if any) is discarded and the caveat concerning the negative value is ignored. The standard (two tailed) tables are used in the construction t_c for pH and similar monitoring constituents/parameters.

PART B: PERFORMANCE STANDARD: RISK-BASED
DETERMINE 95 % UPPER CONFIDENCE LIMIT

Analyze soil samples using Methods 8260A from U. S. EPA document <u>SW-846 Test Methods for Evaluating Solid Waste</u>, (3rd edition, 1986, as updated) for determining risk-based closure performance standard. If the test results identify constituent of concern (HCOC) concentration(s) that are not detectable, then divide these MDL(s)/EQL(s) values by two and if the test results identify constituent concentration that are above the MDL/EQL levels but below the PQL levels, then divide these PQL(s) by two. Use the resultant quotients and the test results that are above the PQL as data for incorporation into statistical calculations. Calculate the statistical mean and the 95 percentile upper confidence limit (UCL) using the classical method for data population having a normal distribution and estimate the unbiased average and UCL using Gilbert's lognormal protocols for data population having a "non-normal" distribution. Apply the higher UCL as the reasonable maximum exposure (RME) to determine if the risk-based performance standard is achieved or exceeded.

A. Calculate the "normal" distribution mean (X) and "lognormal" distribution mean (Y).

$X = (X_1+X_2+X_3.....X_n)/n$

$Y_i = \ln(X_i)$

$Y = (Y_1+Y_2+Y_3.....Y_n)/n$

B. Calculate the "normal" distribution variance (S^2_x) and the "lognormal" distribution variance (S^2_y)

$$S^2_x = \frac{(X_1-X)^2+(X_2-X)^2+(X_3-X)^2....(X_n-X)^2}{(n-1)}$$

$$S^2_y = \frac{(Y_1-Y)^2+(Y_2-Y)^2+(Y_3-Y)^2....(Y_N-Y)^2}{(n-1)}$$

C. Using one-tail t values, calculate the "normal" distribution upper confidence limit (UCL_x) and the "lognormal" distribution upper confidence limit (UCL_y). See the above Table 7 for "t" values and the Table 8 contains the H Values.

$UCL_x = X+t_{(0.95,n-1)}*S_x/(n^{.5})$

$UCL_y = EXP^{(Y+0.5*S^2*Y+S*H/((n-1)^.5))}$ where S is S_y

Use the greater upper confidence limit for risk-based calculations.

D. If the data neither exhibits normal or lognormal distribution then apply the highest analytical value to determine the regulatory status of the closure.

H Values
Table 8

Computing One Sided Upper 95% Confidence Limit

Sample Population (n)

S_y	3	5	7	10	12	15	21	31	51	101
0 10	2 750	2.035	1.886	1.802	1 775	1.749	1.722	1.701	1.684	1.670
0.20	3:295	2.198	1.992	1.881	1:843	1.809	1.771	1.742	1.718	1.697
0.30	4.109	2.402	2.125	1.977	1.927	1.882	1.833	1.793	1.761	1.733
0 40	5 220	2.651	2 282	2 089	2 026	1 968	1.905	1.856	1.813	1.777
0:50	6:495	2.947	2.465	2.220	2:141	2.068	1.989	1.928	1.876	1.830
0.60	7.807	3.287	2.673	2.368	2.271	2.181	2.085	2.010	1.946	1.891
0.70	9.120	3.662	2.904	2.532	2.414	2.306	2.191	2.102	2.025	1.960
0.80	10.43	4.062	3.155	2.710	2.570	2.443	2.307	2.202	2.112	2.035
0.90	11.74	4.478	3.420	2.902	2.738	2.589	2.432	2.310	2.206	2.117
1.00	13.05	4.905	3.696	3.103	2.915	2.744	2.564	2.423	2.306	2.205
1.25	16.33	6.001	4.426	3.639	3.389	3.163	2.923	2.737	2.580	2.447
1.50	19.60	7.120	5.184	4.207	3.896	3.612	3.311	3.077	2.881	2.713
1.75	22.87	8.250	5.960	4.795	4.422	4.081	3.719	3.437	3.200	2.997
2.00	26.14	9.387	6.747	5.396	4.962	4.564	4.141	3.612	3.533	3.295
2.50	32.69	11.67	8.339	6.621	6.067	5.557	5.013	4.588	4.228	3.920
3.00	39.23	13.97	9.945	7.864	7.191	6.570	5.907	5.388	4.947	4.569
3.50	45.77	16.27	11.56	9.118	8.326	7.596	6.815	6.201	5.681	5.233
4.00	52.31	18.58	13.18	10.38	9.469	8.630	7.731	7.024	6.424	5.908
4.50	58.85	20.88	14.80	11.64	10.62	9.669	8.652	7.854	7.174	6.590
5.00	65.39	23.19	16.43	12.91	11.77	10.71	9.579	8.688	7.929	7.277
6.00	78.47	27.81	19.68	15.45	14.08	12.81	11.44	10.36	9.449	8.661
7.00	91.55	32.43	22.94	18.00	16.39	14.90	13.31	12.05	10.98	10.05
8.00	104.6	37.06	26.20	20.55	18.71	17.01	15.18	13.74	12.51	11.45
9.00	117.7	41.68	29.46	23.10	21.03	19.11	17.05	15.43	14.05	12.05
10.00	130.8	46.31	32.73	25.66	23.35	21.22	18.93	17.13	15.59	14.26

PART C: PERFORMANCE STANDARD:
RISK-BASED CLOSURE: SESOIL MODEL

When a facility elects to implement RCRA closure to risk-base performance standards, a REAMs fate and transport analysis must be conducted to provide a 30 year projection delineating the migration of the hazardous constituent(s) of concern (HCOC) through the unsaturated and saturated (with water) soils and the HCOC potential impact on the groundwater quality. In preparation for implementing the REAMs SESOIL computer model, the soil characteristics, climatic conditions, and hazardous waste management unit site-specific/event-specific data, as identified below, are incorporated into the SESOIL data base. If this data is not incorporated, SESOIL will retrieve a majority of its data from an existing "default" data base. However, for SESOIL subprogram to properly execute, the user <u>must</u> provide critical soil properties as determined by <u>analyzing soils collected</u> at the site during the RCRA decontamination process. All critical soil properties marked with an asterisk (*) must be identified during site characterization. The remaining properties have been incorporated into REAMS data base.

1. <u>Physical Properties</u>

    Bulk Density; gm/cm^3
    Intrinsic Permeability; cm^2
    Soil porosity; void fraction
    Organic content; % oc
    Soil disconnectedness index (a relationship of soil permeability and soil moisture); dimensionless
    Cation Exchange Capacity (CEC); me/100 grams of soil
    Freundlich exponent (a value used to determine the chemical sorption);

2. <u>Chemical Properties</u>

    Solubility in water; μg/ml*
    Air Diffusion Coefficient; cm^2/sec*
    Henry's constant M^3-atm/mole*
    OC Adsorption Coefficient (K_{oc}); μg/g oc / μg/ml*
    Soil Adsorption Coefficient (K_d); μg/g/μg/ml*
    Molecular weight; g/mole*
    Valence
    Neutral hydrolysis constant; L/mol/day
    Basic hydrolysis constant
    Acid hydrolysis constant
    Liquid phase biodegradation rate; 1/day)
    Solid phase biodegradation rate; 1/day
    Ligand Stability Constant;
    Moles Ligand per mole compound
    Molecular weight of ligand; g/mol

3. <u>Erosion Process Properties</u>

    Washload area; cm^2
    Silt fraction of soil; gr/total gr
    Sand fraction of soil; gr/total gr
    Clay fraction of soil; gr/total gr
    Slope length; cm
    Average land slope; vertical cm/horizonal cm

Soil erodability factor; tons/acre/English EI)
Soil loss ratio; dimensionless
Contouring Factor; dimension less

4. <u>Layer Continuity/Discontinuity Properties</u>

Number of layers; dimensionless
Thickness (each layer); cm
Layer pH (each layer);
Intrinsic permeabilites (each layer);
Biodegradation ratios (compared to first layer); dimensionless
Organic Compound (OC) ratios (compared to first layer); dimensionless
CEC ratios (compared to first layer); dimensionless
Freundlich ratios (compared to first layer); dimensionless
Adsorption ratios (compared to first layer); dimensionless
Manning's Coefficient; dimensionless

(NOTE: If soil adsorption coefficient (K_d) is known, then the organic content adsorption coefficient (K_{oc}) is not required.

Appendix D

List of Constituents of Concern
Laundry Wastewater Clarifier

Analyte	Method	Units	PQL	MDL
Benzene	8260	ug/L	1	1.57
1, 1,2-Trichloroethane	8260	ug/L	1	1.91
Methylene chloride	8260	ug/L	1	2.04
Carbon disulfide	8260	ug/L	10	x
Carbon tetrachloride	8260	ug/L	1	1.68
Chlorobenzene	8260	ug/L	1	1.54
o-Cresol	8270	ug/L	10	2.18
p-Cresol	8270	uq/L	10	2.09
1,2-Dichlorobenzene	8260	ug/L	1	1.43
Isobutanol	GC/FID	%	0.1-1	x
Methanol	GC/FID	%	0.1-1	x
Methyl ethyl ketone	8260	ug/L	50	11.02
Nitrobenzene	8270	ug/L	10	1.14
Pyridine	8270	ug/L	10	1.54
Tetrachloroethylene	8260	ug/L	1	1.63
Toluene	8260	ug/L	1	1.54
1,1,1-Trichloroethane	8260	ug/L	1	1.79
1,1,2-Trichloro-1,1,2-trifluoroethane	8260	ug/L	1	x
Trichloroethylene	8260	ug/L	1	1.76
Trichlorofluoromethane	8260	ug/L	1	x
Napthalene	8270	ug/L	10	0.82
M-Dichloroethane	8260	ug/L	1	1.98
Chloroform	8260	ug/L	1	1.65
Butylbenzyl Phthalate	8270	ug/L	10	1.08
Bis(2-ethylhexyl) Phthalate	8270	ug/L	10	0.63
Barium	6020	ug/L	5	0.96
Cadmium	6020	ug/L	5	1.46
Lead	6020	ug/L	5	1.45
Mercury	6020	ug/L	1	0.33
Selenium	6020	ug/L	5	4.95
Silver	6020	ug/l	5	0.2
Zinc	6020	ug/L	5	1.06

Notes:

1. Cresols will be reported as o & p isomers as above.
2. 1, 1,2-trichloro-1, 1,2-trifluoroethane and ethyl ether are used in the extraction lab as prep methods. for other analyses and may show up as background.
3. Compounds where there is currently no MDL study (x) the PQL should be considered an EQL (estimated quantitation limit). However, PSS does have experience with a few of these compounds: 2-nitropropane, 2-ethoxyethanol and ethyl acetate.

Appendix E
LANDFILL STRUCTURE TEST METHODS

CLAY LINER TESTING METHODS

1. ASTM D2922 is a nuclear method and ASTM D2937 is a drive ring method.
2. In addition, at least one test should be performed each day soil is compacted and additional tests should be performed in areas for which QA personnel have reason to suspect inadequate compaction.
3. Every twentieth sample tested with ASTM D2922 or ASTM D2937 will be tested (as close as possible to the same test location) with the sand cone (ASTM D1556) or balloon method (ASTM D2167) to aid in identifying any systematic calibration errors with ASTM D2922 or ASTM D2937. Methods D1556 and D2167 may be used in lieu of ASTM D2922 and ASTM D2937.
4. ASTM D3017 is a nuclear method and ASTM D4643 is microwave oven drying.
5. Every tenth sample tested with ASTM D3017 or ASTM D4643 will be also tested by direct oven drying (ASTM D2216) to aid in identifying any significant, systematic calibration errors with ASTM D3017 or ASTM D4643.

DRAINAGE LAYER TESTING METHODS

1. ASTM D2922 is a nuclear method and ASTM D2937 is a drive cylinder method.
2. In addition, at least one test should be performed each day soil is compacted and additional tests should be performed in areas for which QA personnel have reason to suspect inadequate compaction.
3. Every twentieth sample tested with ASTM D2922 or ASTM D2937 will be tested (as close as possible to the same test location) with the sand cone (ASTM D1556) or balloon method (ASTM D2167) to aid in identifying any systematic calibration errors with ASTM D2922 or ASTM D2937. Methods ASTM D1556 and ASTM D2167 may be used in lieu of ASTM D2922 and ASTM D2937.
4. ASTM D3017 is a nuclear method and ASTM D4643 is microwave oven drying.
5. Every tenth sample tested with ASTM D3017 or ASTM D4643 will be also tested by direct oven drying (ASTM D2216) to aid in identifying any significant, systematic calibration errors with ASTM D3017 or ASTM D4643.

SOIL BACKFILL TESTING METHODS

1. ASTM D2922 is a nuclear method and ASTM D2937 is a drive cylinder method.
2. In addition, at least one test should be performed each day soil is compacted and additional test should be performed in areas for which QA personnel have reason to suspect inadequate compaction.
3. Every twentieth sample tested with ASTM D2922 or ASTM D2937 will be tested (as close as possible to the same test location) with the sand cone (ASTM D1556) or balloon method (ASTM D2167) to aid in identifying any systematic calibration errors with ASTM D2922 or ASTM D2937. Methods ASTM D1556 and ASTM D2167 may be used in lieu of ASTM D2922 and ASTM D2937.
4. ASTM D3017 is a nuclear method and ASTM D4643 is microwave oven drying.
5. Every tenth sample tested with ASTM D3017 or ASTM D4643 will be also tested by direct oven drying (ASTM D2216) to aid in identifying any significant, systematic calibration errors with ASTM D3017 or ASTM D4643.

Appendix F

CLOSURE, CONTINGENT CLOSURE, AND POST CLOSURE SCHEDULES

Schedule for Closure of Surface Impoundment Area (SIA)

Closure Procedure	Day
Closure plan approval.	0
Submit a site map as identifying the location and dimensions of the SIA.	30
Establish grid and sample.	30
Calculate appropriate number of samples necessary to characterize area.	45
Generate risk-based performance standards.	45
Calculate upper confidence interval.	45-60
Compare contaminant concentrations using a one tailed t-Test at the 95% confidence level to determine significant increase in excess of the closure performance standard for specific contaminant.	45-60
Removal of contaminated soil, sampling, analyses, comparison of CI with the closure performance standard, if necessary.	90-150
Submit soil sampling analytical results, statistical comparison to VDEQ.	180
Advise VDEQ that the performance standards were achieved and submit corroborate evidence. However, if performance standards were not attainable, notify VDEQ that the contingent closure and post-closure plans will be implemented.	180
Submit to VDEQ the PE and owner/operator certify closure completion.	240

CONTINGENT CLOSURE AND POST-CLOSURE SCHEDULE

Activity	Time (days)
Determination that closure not feasible.	0
Advertise/Award closure contract	30
Sample background soils and determine the seasonal low water table elevation. Construct or use an existing decontamination area.	40
Submit background test results and an estimate of the seasonal low water table elevation to the VDEQ for approval.	50
Conduct sampling and analysis of the soils lying beneath and adjacent to the surface impoundment.	70
Conduct statistical comparisons between background soils and soils lying beneath and adjacent to the surface impoundment and submit the results to the VDEQ. If closure has not been achieved, notify the VDEQ in writing and implement the contingent closure plan. Prepare and submit design drawings for contingent closure cap and drainage system designs.	80-110
Sample borrow sources and analyze samples in accordance with the requirements required in the contingent closure plan.	110-130
If closure is not achieved, begin construction of the cover. Backfill excavated area and conduct testing in accordance with Table 4. Placement and P.E. inspection of 2 feet of clay in accordance with Table 5.	140
Vegetation and P.E. inspection of the cover. Construct perimeter fence and install warning signs. Establish permanently surveyed benchmarks. Sample all potentially contaminated (or decontaminated) equipment and analyze samples.	170
Submit analytical results to the VDEQ to confirm that all equipment has been decontaminated. If the decontamination area liner has been torn, then implement sampling, analysis, and remediation plan to evaluate and remediate, as appropriate, the area beneath the pad.	175
Submit GMP to the VDEQ for review and approval.	180
Begin post-closure care and maintenance. To continue as per the VHWMR until a post-closure permit is issued.	180
Submit P.E. and owner and operators certification of contingent closure to the	

VDEQ along with all QA/QC documentation. Submit survey plat to local zoning authority and VDEQ which notes restrictions for future land use as required under the VHWMR 9 VAC 20-60-580.G. and notices required under the VHWMR 9 VAC 20-60-580.J.	180-240
Submit post-closure care permit application and permit fee to the VDEQ.	290
Post-closure care groundwater monitoring and maintenance to be performed over a 30 year period.	30 yrs
Submit owner and operators and P.E. certification of completion of post closure care	30 yr.+60 days

Appendix G

POST-CLOSURE CARE INSPECTION CHECKLIST

ITEM | TYPE OF PROBLEM | STATUS

I. Cap
- a. Uniformity of Surface____________________
- b. Any visible damage____________________
- c. Imperfections, holes, cracks, thin, spots, foreign material____________________
- d. Evidence of settling/subsidence____________________
- e. Evidence of erosion____________________

II. Vegetation
- a. General condition____________________
- b. Foreign items, trees, bushes, etc.____________________

III. Groundwater Monitoring Wells
- a. Any visible damage to cap, casing, annular seal or other problems____________________

IV. Survey Benchmarks
- a. Free of obstructions or debris ____________________

V. Fence
- a. Any visible damage to fence ____________________

VI. Sign(s)
- a. Any visible damage or obstructions____________________

VII. Miscellaneous:

Inspector's Name__________

Date/Time of Inspection__________

Supervisor contacted when any problems are detected.__________

Corrective action taken__________

Other remarks__________

Supervisor's signature__________

Note: All completed checklists will be filed by the owner/operator.

Appendix H

CLOSURE COST ESTIMATES
CONTINGENT CLOSURE COST ESTIMATES
CONTINGENT POST-CLOSURE COST ESTIMATES

CLOSURE AND CONTINGENT CLOSURE WORST CASE COST ESTIMATE

ACTIVITY		COST
Testing concrete/soil contamination (35 samp @ $1,200/sample)	$	42,000
Clarifier Decontamination (Lump Sum)	$	5,000
Foundation/pad removal and disposal at a Subtitle D Landfill (40 yd^3 @ $240/$yd^3$)	$	3,600
Contaminated soil removal and diposal, at a Subtitle D Landfill (110 yd^3 @ $80/$yd^3$)	$	8,800
Certification of final closure (80 hr @ $90/hr)	$	7,200
Inspection and repairs (48 ft fence @ $69/ft)	$	3,306
Final cover (12 ft^3 @ $567 ft^3)	$	6,734
Revegetation (436 ft^2 @ $0.15/$ft^2$)	$	68
Groundwater monitoring well construction (4 wells @ $8,689/well) (Complete)	$	0
Groundwater monitoring (4 wells @ $12,691/well)	$	50,765
Survey plan-final closure (3 hr @ $199/hr)	$	597
Subtotal	$	128,070
Contingency (15%)	$	19,210.50
Total closure cost	$	147,280.50

POST-CLOSURE COST ESTIMATE

ACTIVITY		COST
Notation of property deed final closure (20 hr @ $92)	$	1,834
Maintenance of waste management area boundaries (15 post replacements @ $165/post)	$	2,480
Facility inspection (30 inspections @ $500/insp)	$	15,000
Routine maintenance and repair (2 visits/yr*30 yr @ $625/visit)	$	37,500
Severe erosion damage repair (3 yd^3 over 30 yr @ $300/yr*$yd^3$)	$	27,000
Semi-annual Groundwater monitoring (4 wells x 2 events per yr over 30 yr @ $2,100/well)	$	504,000
Maintenance of Moniotirng Wells (4 wells @ $100/well/year over 30 yrs)	$	12,000
Certification of post-closure (8 hr/yr*30yr @ $90/hr)	$	21,600
Subtotal	$	621,414
Contingency (15%)	$	93,212
Total Estimated Post Closure Cost	$	714,626

Appendix I

Demonstration of Surface Contamination Concentration by Swabbing

The intent is to collect at least eight random discrete swab samples to statistically demonstrate that the facility is RCRA "clean". The samples from eight random locations (four locations on the walls and four locations on the bottom) on the concrete surface. In addition to the samples from each unit, trip blanks will be prepared by the laboratory and will accompany the sampling team from the beginning of the operation to the transfer of the samples to the custody of the laboratory. The laboratory will provide materials (i.e., distilled water, gauze and clean containers) to be utilized by the sampling team for the sampling and preparation of the field and equipment blanks identified below.

A SAMPLING PROCEDURES

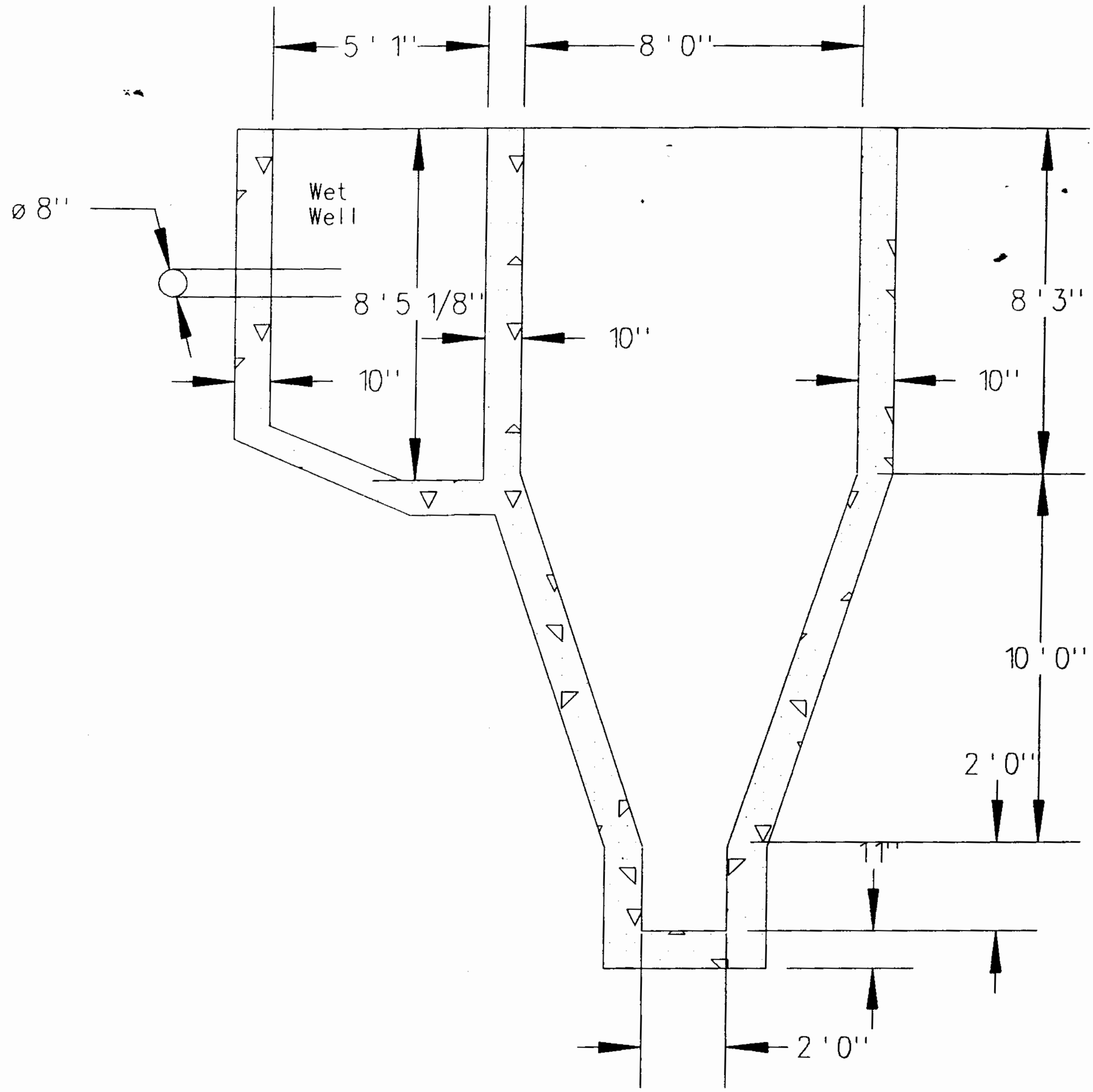
Each sample location is established by two random numbers generated using calculator or random number tables.

- An origin will be established.
- Eight random number pairs were generated (for both sides and bottom){(X1,Y1); (X2,Y2); (X3,Y3); (X4,Y4); etc} with each X value being a number between 0 and the perimeter in feet, and each Y value being a number between 0 and the depth of the unit in feet for the side samples or 0 and the radius of the unit in feet for the bottom samples.
- Each X value will be located along the perimeter of the unit by measuring, along the perimeter, clockwise X feet from the origin.
- A line will be established from each point set on the perimeter through the center of the unit at the deepest area of the unit.
- X and Y values will be determined randomly.
- The sampling point will be the first point on that line which is at depth X for the side samples, or at a distance Y from the perimeter to the center for the bottom samples.
- The sample will be taken as described in "Sampling Procedure" identified below.

B. SAMPLING PROCEDURE

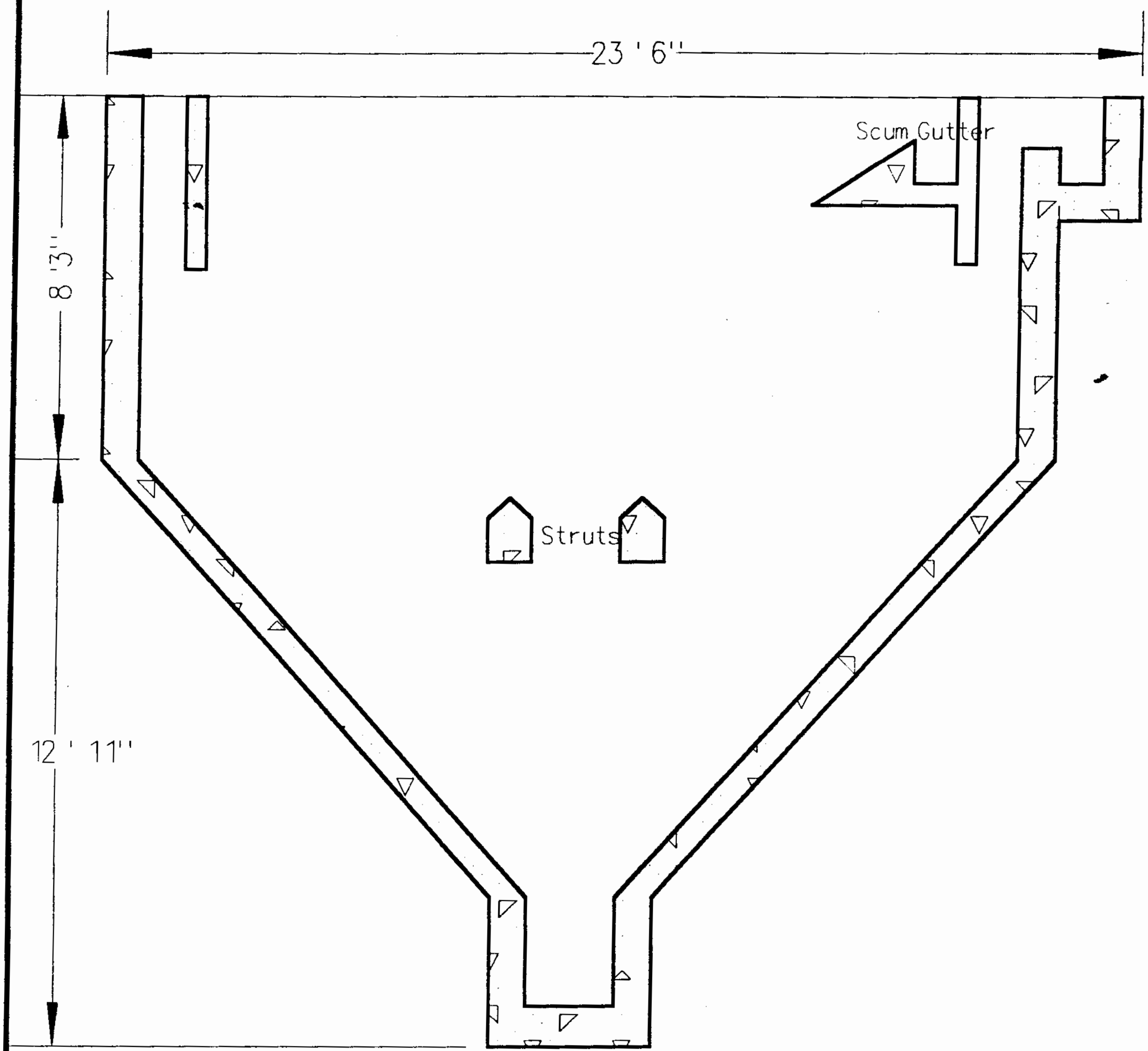
Eight random sampling locations will be determined per the specific instruction as delineated above. At each unit) the eight sampling locations will first be measured off to create one foot of square area. Each of the eight one foot square areas will be scraped with a dedicated hard rubber spatula to remove as much of the surface film as is practical. The scraped surface film materials will be transferred to a laboratory supplied clean wide mouth 120 milliliter transparent glass soil sampling jar will be submitted for the analyses of hazardous waste constituents of concern (HCOC). The sample will be correctly identified and placed in a cooler at 40°C. After the surface film has been removed from the designated sampling area, a high pressure (10,000 psi) cold water spray utilizing plant well water, will be used to clean any remaining film or sludge from the designated sampling area. One field blank of the cold wash water will be collected for laboratory analysis. The field blank will be analyzed for HCOC.

Following the high pressure water wash, a gauze pad(s) will be saturated with hexane and used to thoroughly swab down the one foot square area. The gauze pad(s) will be transferred to a labeled laboratory supplied clean transparent wide mouth 120 milliliter glass jar for laboratory analyses. The gauze pad(s) will be analyzed for HCOC. The field blank for each of the vessels will consist of (1) de-ionized water poured over a clean unused spatula into a laboratory supplied clean translucent one liter plastic bottle for HCOC and (2) the sampling gauze-soaked in a hexane solution provided by the laboratory and placed in a clean 120 ml glass jar for HCOC. This procedure will be followed inside of each of the units to account for any environmentally induced variability in the data.



Scale 1'' : 4 '

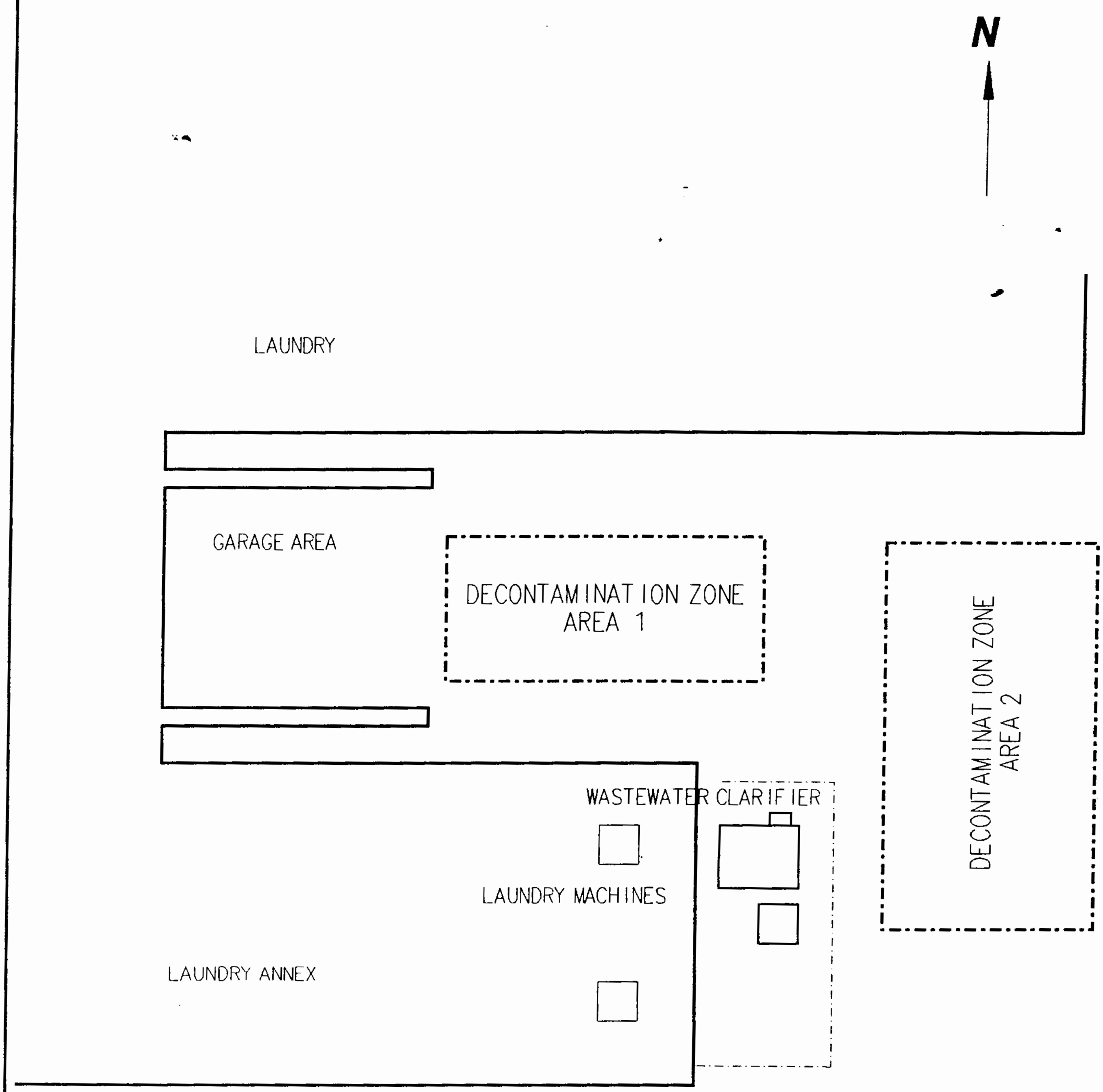
LORTON CORRECTIONAL FACILITIES - LORTON, VA WASTEWATER CLARIFIER SIDE VIEW	
Project Code : E-2937-0 12	AAS Environmental, Inc.
Figure # 5	



Scale 1'' : 4 '

LORTON CORRECTIONAL FACILITIES - LORTON, VA
WASTEWATER CLARIFIER
FRONT VIEW

Project Code: E-2937-012	AAS Environmental, Inc.
Figure # 6	



LORTON CORRECTIONAL FACILITIES - LORTON, VA
LAUNDRY WASTEWATER CLARIFIER CLOSURE
DECONTAMINATION ZONES

Project Code: E-2937-012	AAS Environmental, Inc.
Figure # 7	

Appendix A
Deed Restriction Language

NOTICE OF USE LIMITATION
9VAC20-60-580.B. & 9VAC20-60-800.B., VHWMR

Hazardous Waste Site Name:

I.D. No.:

This Notice of Use Limitation ("Notice") is made as of the ______ day of ____________________, 19____, by [Name and address of current property owner or owners], together with his/her/its/their successors and assigns, (collectively "Owner").

WITNESSETH:

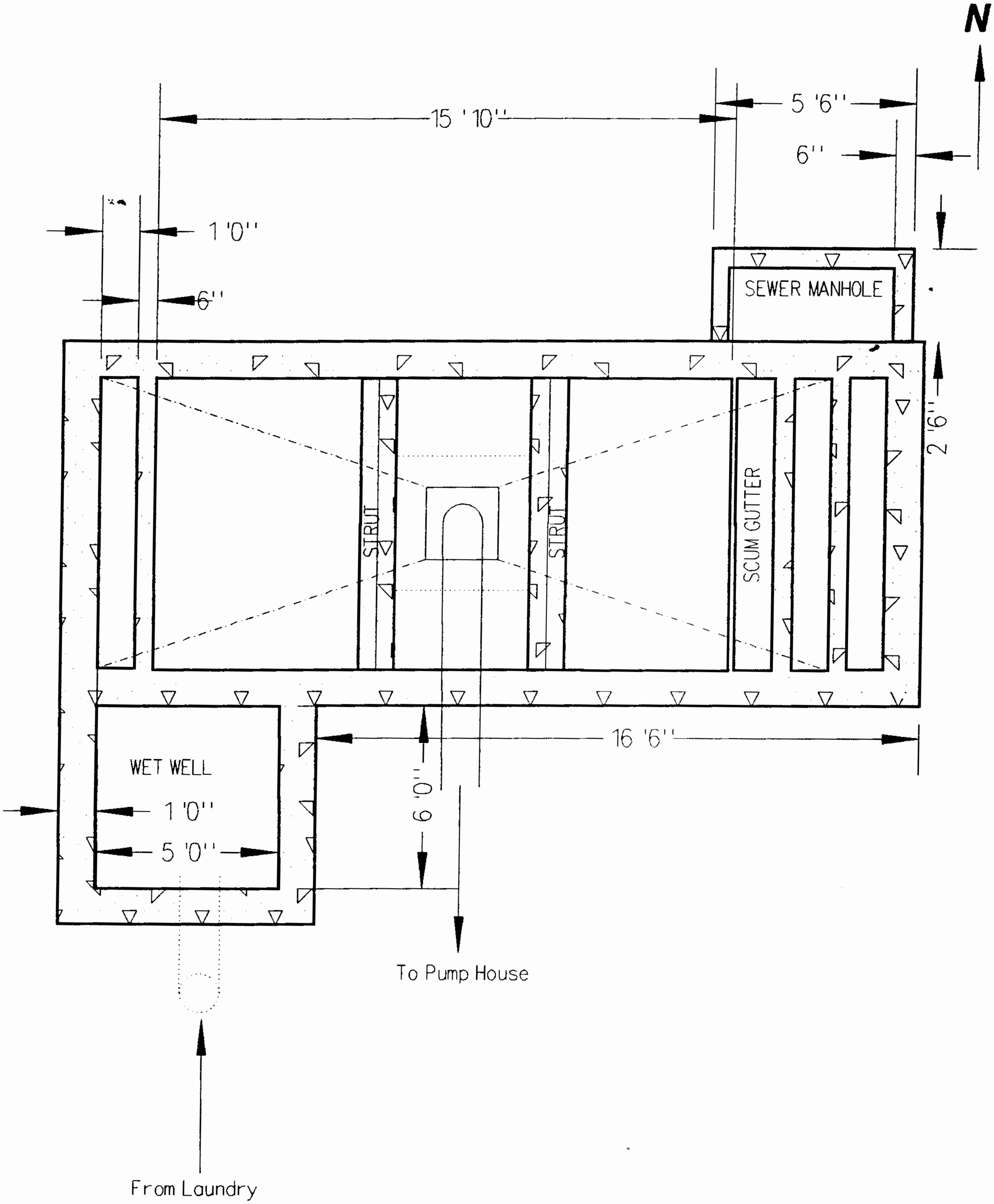
WHEREAS, __________________ (name of Owner), of ________________ County, Virginia, [is][are] the owner(s) in fee simple of [that][those] certain parcel(s) of [vacant] land located in __________________ (Town/City), ____________________ County, Virginia, with the buildings and improvements thereon,)"Property");

WHEREAS, said parcel(s) of land, which is more particularly bounded and described in Exhibit A, attached hereto and made a part hereof (□the Property□) is subject to this Notice of Use Limitation. The Property is shown on a plan [recorded and/or registered herewith][recorded and/or registered in ____________________ County Registry of Deeds/Land Registration Office in Plan Book _____, Plan _____, or as Land Court Plan No. _______.];

[WHEREAS, a portion of the Property is more specifically subject to this Notice of Use Limitation. This portion of the Property is more particularly bounded and described in Exhibit A-1, attached hereto and made a part hereof. This portion is shown on a plan [to be recorded herewith][recorded in ________________ County Registry of Deeds in Plan Book _______, Plan _______.];

WHEREAS, the Property [portion of the Property] comprises [all][part of] a disposal site as the result of a release of hazardous waste. Exhibit A-1 is a sketch plan showing the relationship of the [Property][portion of the Property] subject to this Notice of Use Limitation to the boundaries of said disposal site (to the extent such boundaries have been established). Exhibit A-1 is attached hereto and made a part hereof.]

WHEREAS, one or more response actions have been selected for [the Disposal Site][portion of the Disposal Site] in accordance with closure performance standards of § 9VAC20-60-580.B., or 9VAC20-60-800.B., of Virginia Hazardous Waste Management Regulations. Said response actions are based upon (a) the restriction of human access to and



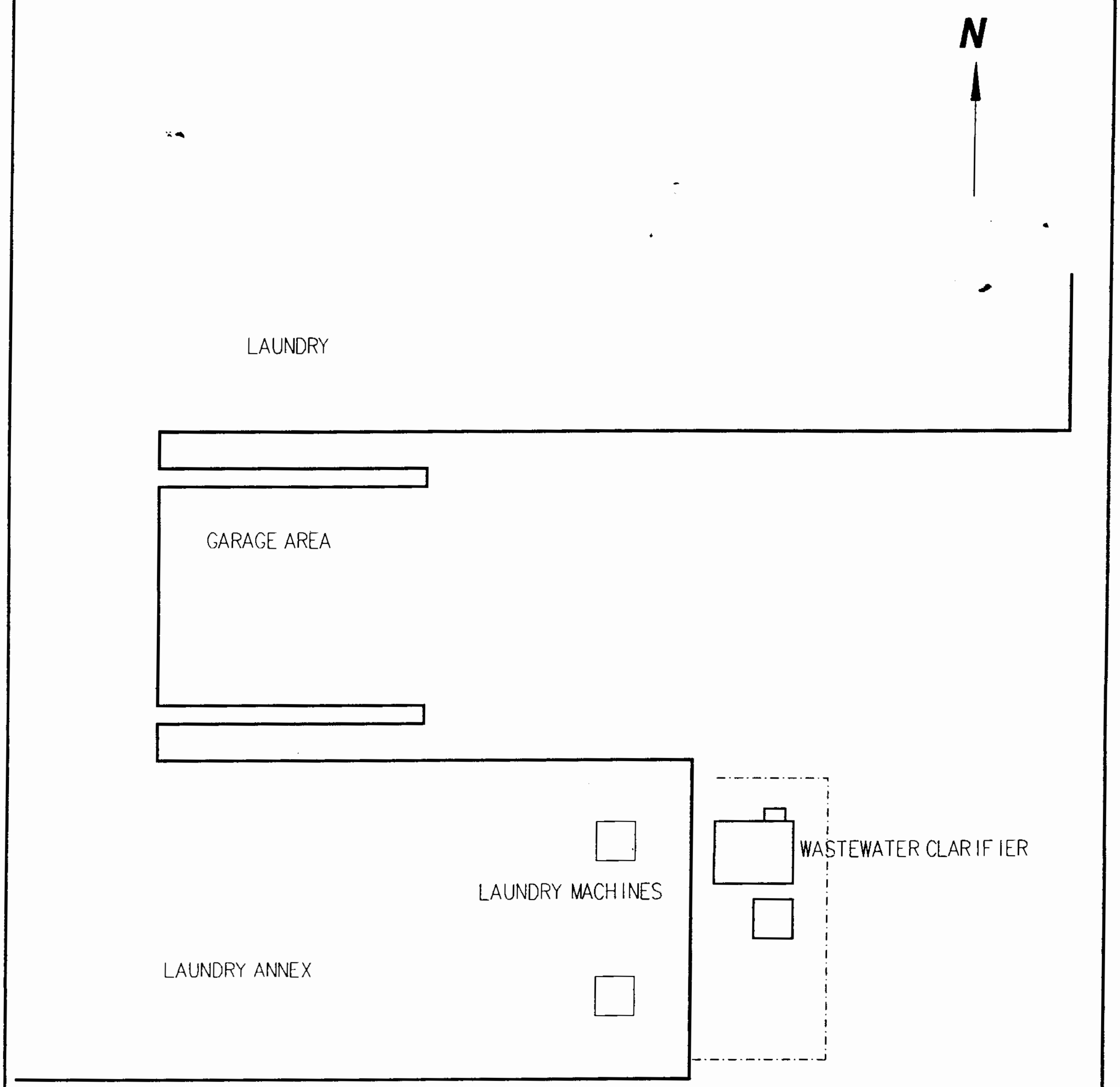
LORTON CORRECTIONAL FACILITIES – LORTON, VA
WASTEWATER CLARIFIER
TOP VIEW

Project Code: E-2937-012

Figure # 4

Scale 1'' : 4 '

AAS Environmental, Inc.



LORTON CORRECTIONAL FACILITIES - LORTON, VA

WASTEWATER CLARIFIER SITE

Project Code: E-2937-012	AAS Environmental, Inc.
Figure # 3	

CLOSURE PLAN, CONTINGENT CLOSURE PLAN, POST CLOSURE PLAN

Surface Impoundment Area (Laundry Wastewater Clarifier)
District of Columbia Department of Corrections
Lorton Correctional Complex
Lorton, Virginia

EPA I.D. VAD980930988

April 2, 2001

TABLE OF CONTENTS

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1.0 INTRODUCTION

In accordance with the *Virginia Hazardous Waste Management Regulations,* as codified in the *Virginia Administrative Code*, Title 9, Agency 20, Chapter 60 [9 VAC 20-60-12, *et. seq.*], closure of the laundry waste clarifier as a hazardous waste management unit will be accomplished per this Closure Plan. Please note, through-out this closure plan reference to 40 CFR §§ 264, 265, and 270 shall be per 9 VAC 20-60-264, 265, and 270, which adopts by reference those portions of the Federal Regulations.

2.0 SITE DESCRIPTION

The subject of this Closure, Contingent Closure, and Post Closure Plan is a RCRA Surface Impoundment Area (SIA) identified as a laundry wastewater clarifier (including ancillary equipment such as 8" laundry feed line to wet well, scum gutter, accumulation volute, and pipe removing the contents from the volute and transporting to the pump house).

This laundry wastewater clarifier is located inside the Lorton Correctional Facility's Central Facility in Lorton, Virginia, in southern Fairfax County just east of I-95 (Figure 1). The clarifier is adjacent to the Central Facility's laundry as shown in Figure 2. A chain link fence on three sides and the Laundry Annex building wall on the West Side encloses it. A small brick pump house is located in the southeast corner of the fenced enclosure. A brick paved driveway is on the north and east sides. The driveway is used to provide access to the loading dock for the Laundry. A grassy area lies to the south of the clarifier.

The laundry wastewater clarifier is a reinforced concrete and brick structure with rectangular plan dimensions of about 24 feet by 15 feet and a capacity of approximately 20,000 gallons. It extends downward to a depth of approximately 22 feet, where it tapers to a sump. It has three vessels: the clarifier proper, an adjacent wet well (both of 10 to 11 inch thick reinforced concrete), and an adjacent brick enclosure of unknown function. Cast-iron and steel piping transported wastewater to the clarifier and to the wet wells from the laundry, and connected the clarifier to an adjacent pump house. Excess water drained from the clarifier (via a sewer manhole) and from the wet well to sewers through 8 inch piping. The clarifier proper is covered in part with a metal grating and in part with light screening; the wet well is covered with a metal grate; and the brick enclosure is uncovered. Prior to being emptied, the clarifier was estimated to contain approximately 16,500 gallons of waste, consisting of around 150 gallons of scum and oily material, 3,000 gallons of liquid and 13,350 gallons of sludge. A plan of the area immediately surrounding the clarifier is provided in Figure 3. Top, front and side views of the clarifier are provided in Figures 4, 5, and 6 respectively.

The site is located on the nearly flat crest of a broad ridge, at an elevation of approximately 225 feet above mean sea level. The site slopes gently to the southeast, and drains into an intermittent tributary of Giles Run.

3.0 IDENTIFICATION OF HAZARDOUS WASTE MANAGEMENT UNIT

The clarifier, built in the 1940's, functioned as a wastewater clarifier for the Central Facilities' industrial laundry operation. The clarifier allowed solids, such as rags, lint, soil, etc. to settle out of the wastewater. A sludge pump, located in a small pump house building adjacent to the clarifier, was used to remove the solids (or sludge) from the bottom of the clarifier. The sludge pump was broken at some point during operation of the clarifier, and sludge and scum had not been removed for some time. In addition to standard laundering operations, the industrial laundry provided cleaning services for ink-soaked printing rags generated by the U.S. Bureau of Printing and Engraving and the Government Printing Office as well as performing laundry services for the D.C. Morgue. The industrial laundry operation was shut down on November 10, 1995, according to Office of Facility Management personnel at the Lorton Correctional Facility. At the time of the May 1998 inspection by the DEQ's Northern Virginia Regional Office the clarifier was filled with solid waste from waste inks, solvents, oil and grease that formed waste scum, liquid, and sludge.

The Central Facilities domestic laundry operation remains active at Lorton, providing laundry service for inmate clothing and linens. The wastewater generated by the domestic laundry operation is discharged separately into the sewer, bypassing the clarifier. The domestic laundry operation does not impact the clarifier.

3.1 Recent Sampling Events

On April 1 and 8, 1999, AAS Environmental and Safety Kleen Inc. retrieved samples from the clarifier in order to characterize the contents of the clarifier prior to removal and disposal of the contents. The clarifier contained three layers of waste.

The first samples were collected on April 1 from the main vessel of the clarifier (noted as P1) and were designated by a three-part label. The first part indicates the vessel from which the sample was taken. The second part denotes the level from which the sample was taken (S1) for the shallowest levels and higher numbers for progressively deeper levels. The third part denotes whether the sample was a discrete (Grab) sample or a composite (Comp) sample. Grab samples were stored in 40 milliliter glass container's (VOA vials) for analysis of volatiles by EPA 8260, and in one liter containers for analysis of semi-volatiles by EPA 8270. Composite samples were placed in one liter containers for analysis of RCRA metals (total), viscosity, ash, BTU's, total solids, total chlorine by ASTM D 808, Herbicides by U. S. Environmental Protection Agency (EPA) Method 8151, Pesticides/PCB's by EPA Method 8081/8082, and pH by Method 150.1.

The topmost layer of scum was observed to be about one inch thick and lay approximately 45 inches below the top of the clarifier. A one-quarter-inch oily layer lay beneath. One grab sample (P1S1, Grab) was taken. Samples were collected from each of the four quadrants of the clarifier and combined as a composite sample (PIS1, Comp) in a stainless steel bowl in order to create a homogenous sample, which was placed into two one-liter containers. All samples were put into a cooler, packed with ice, and transported to Gascoyne Laboratories, Inc. in Baltimore, Maryland under chain of custody.

A middle layer of mostly water, approximately two feet thick, lay below the scum layer. A disposable bailer was used to collect a grab sample (PIS2, Grab) for volatile that was stored in a

VOA vial, and an additional bailer was used to collect a grab sample (PIS2, Grab) that was placed in a one liter container and semi-volatile analysis. A disposable bailer was used to collect samples from each of the four quadrants. These samples were then combined in a stainless steel bowl to create a homogenous sample (PIS2, Comp) which was placed in two one-liter containers to be analyzed for multiple analytes as described above.

The lower layer consists of a penetrable sludge, starting at five feet below the top of the clarifier and continuing to the bottom. On April 1, 1999, sampling was attempted by pushing a 1" diameter PVC pipe to a depth of 12 feet below the top of the clarifier. This attempt was unsuccessful.

On April 8, 1999, the Safety Kleen sampling crew and our representative remobilized to collect samples from the sludge. A grab sample (PIS3, Grab) for volatile analysis was collected with a hand auger at a depth of approximately 10 feet below the top, of the concrete. An additional grab sample (P1S3, Grab) was collected for volatile and semi-volatile analysis. A hand auger was used to collect samples from each of the four quadrants at depths from 6 to10 feet below the top of the concrete within the sludge. The samples were combined to create a homogenous grab sample (PIS3, Comp).

On April 8, 1999, the sampling crew and our representative also sampled the second vessel shown on the drawings (see Figure 4) as the "wet well". Samples from the vessel were designated in the first descriptor as P2.

The topmost layer of scum and oil, approximately 45 inches below the top of the clarifier, was observed to be about one quarter inch thick. The sampling consisted of one grab sample (P2S1, Grab) for volatile and semi-volatile analysis. Samples were also collected from four locations within the wet well and combined as a composite sample (P2S1, Comp).

The hand-auger sampling method was also used to sample the lower portions of the wet well. A grab sample (P2S2, Grab) for volatile analysis was taken at a depth of approximately 10 feet below the top of the concrete. An additional grab sample (P2S2, Grab) was collected for volatile and semi-volatile analysis. A hand auger was used to collect samples from locations at various depths within the sludge. The samples were combined to create a homogenous sample (P2S2, Comp).

3.2 Results of Sampling and Waste Characterization

The results demonstrate that the uppermost layer in the clarifier had accumulated a mixture of solvents (both chlorinated and non-chlorinated) and plasticizers. The layer directly below that contained water contaminated by contact with the solvents and plasticizers. Solvents and plasticizers also contaminated the layer of sludge at the bottom of the clarifier. The sludge layer also contained significant concentrations of barium and lead, but relatively low concentrations of other heavy metals. However, both barium and lead concentrations were lower than regulatory limits based on the Toxicity Characterization Leaching Procedure (TCLP) analyses.

3.3 Hazardous Waste Determination

The results of the sampling demonstrate that the clarifier contents are a hazardous waste as defined in 9 VAC 20-60-261, adopting 40 CFR § 261 by reference. The contents were classified as characteristic hazardous waste carrying the code D001 for an ignitable liquid. The flash point of two of the samples from the clarifier contents was 130 °F. The Hazardous Waste Codes F002, F003, and F005 were added for a non-specific source due to residual concentrations of solvent compounds and the nature of what was laundered at the facility. The contents of the clarifier were removed and transported to licensed recycling, treatment or disposal facilities in September and October 1999.

3.4 RCRA Closure Intent

The RCRA Closure Plan for the Lorton facility describes the procedures which will be followed to arrange for the proper closure of the hazardous waste management unit at the property. The primary objective of this plan is to provide appropriate protection of human health and the environment after closure of the waste unit. Lorton shall satisfy the closure performance standards as described in this plan. No post-closure procedures for soil shall be required unless implementation of the contingent closure plan becomes necessary in accordance with this plan. Closure of the groundwater must be performed in accordance with the groundwater monitoring plan (GMP) submitted by the facility, which was approved separately by the Virginia Department of Environmental Quality (VDEQ).

Lorton will maintain copies (office) of the approved Closure Plan, and all approved amendments to this plan, on-site until certifications of closure have been submitted and acknowledged as being acceptable by the VDEQ. Lorton will submit to VDEQ, Waste Division (within 60 days after completing closure activities) a certification by the owner/operator and an independent professional engineer (P.E.) registered in the Commonwealth of Virginia that the laundry wastewater clarifier was closed in strict accordance with all specifications and procedures stipulated in this approved closure plan. This shall be done in accordance with 40 CFR § 264.115. The primary contact person during the closure period shall be:

Ajay Kapoor, P.E., General Engineer
District of Columbia Department of Correction
8515 Silverbrook Road
Lorton, Virginia 22079
(T) 703-643-6701
(F) 703-6432-1108

Mailing Address:
District of Columbia, Department of Corrections
Office of Facilities Management
Attn: Ajay Kapoor
P.O. Box 25
Lorton, VA 22079

If the designated contact person changes prior to completion of closure, Lorton shall notify VDEQ in writing at least 30 days prior to such change, or as soon thereafter as is feasible.

Pursuant to 40 CFR § 265.113(b), Lorton will submit a written extension request to VDEQ for consideration at least 30 days prior to the existing deadline of closure completion if the closure will require more than 180 days to complete.

In accordance with 40 CFR § 265.112, the owner/operator may amend the closure plan prior to notification of the partial or final closure of the facility. An owner/operator with an approved closure plan shall submit a written request to the Director to authorize a change to an approved closure plan The written request shall include a copy of the proposed amended closure plan for the approval of the Director.

3.5 Closure Performance Standards

With approval and implementation, this Closure Plan will close the surface impoundment in a manner that:

1. Minimizes the need for further maintenance;
2. Controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment: post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated runoff or waste decomposition products to the ground water, surface water or to the atmosphere; and
3. Complies with the requirements of 40 CFR §§ 264 and 265, as applicable.

This plan requires the removal of any liquid, soil and residual contamination present in or around the waste unit to the extent that the remaining soil and residual contaminants do not pose an unacceptable threat to human health and the environment as demonstrated by the residential or industrial (with the appropriate deed restrictions similar in form to those provided in Appendix A of this closure plan) scenario. It also requires the safe and effective termination of disposal operations and activities to minimize harmful effects upon human health and the environment and eliminate post-closure migration of contamination, contaminated run-off, or waste decomposition products to the soil, groundwater, surface water, or atmosphere. This closure plan addresses only closure of the concrete, piping, and, soils at the unit in question. Closure of groundwater must be performed in accordance with the VDEQ approved GMP. The contingent closure and post-closure plans specify procedures to be followed in the event that soils, concrete, and/or, piping cannot be clean closed for this unit.

To demonstrate that removal of hazardous waste and hazardous waste constituents (i.e., risk-based closure, see Appendix B) from the soil was achieved, Lorton will compare the potentially contaminated sample (rinseate, soil, etc.) analytical results with background, residential or industrial risk-based performance standards using appropriate statistical protocols identified in EPA SW-846, 3rd Edition, Chapter 9; EPA document entitled, "STATISTICAL ANALYSIS OF GROUNDWATER MONITORING DATA AT RCRA FACILITIES (April 1989 and April 1992)" ; and delineated in Appendix C. Closure is achieved and the closure performance standards for soil met when all hazardous waste and hazardous waste constituents are below background or the residential or industrial risk-based performance standards. If it is demonstrated that the constituents of concern do not pose a risk to the environment and human health, then the facility will be deemed clean closed. Closure of the groundwater must be addressed separately under the GMP.

4.0 HAZARDOUS WASTE REMOVAL ACTIVITIES

Environmental Waste Services, Inc., of Chantilly, Virginia, was contracted for proper removal, transportation, and disposal of the clarifier contents. The contract scope of work included removal of the contents from all three clarifier vessels, dismantling and removal of the sludge piping, pressure wash decontamination of the walls of the clarifier, and capping the clarifier to prevent rain from entering it. The work was initiated on September 13, 1999, and was completed with the final hazardous waste container manifested and transported on October 14, 1999.

To prevent rainwater from entering the clarifier, a cover constructed of plywood and polyethylene sheeting was fitted on top of the clarifier. The cover is vented to allow the escape of any residual volatile organic compounds. During the October 18, 1999, site inspection, approximately 75 gallons of water was observed in the main vessel approximately 18 feet below the top. On November 1, 1999, approximately 400 to 500 gallons of water were observed in the clarifier. Currently the clarifier contains approximately 10, 000 gallons that resulted from a broken water line next to the unit. The final removal activities will be documented in the Closure Report.

5.0 PARTIAL CLOSURE ACTIVITIES

No partial closure procedures are necessary because the Lorton Correctional Facility is closing and therefore, will not be using the clarifier in the future.

6.0 MAXIMUM WASTE INVENTORY

The maximum waste handling capacity of the clarifier is approximately 20,000 gallons. The clarifier was emptied in September to October 1999. However, as of October 18, 1999, approximately 75 gallons of water had entered the clarifier. On November 1, 1999, the clarifier was observed to contain approximately 400 to 500 gallons of water. De-watering and equipment decontamination activities during excavation of the clarifier structure are estimated to generate approximately 500 to 1,000 gallons of potentially contaminated liquid. If removal of the clarifier is required, a 2 to 4 foot radius excavation around the outside edges of the clarifier to a depth of 22 feet, approximately 500 cubic yards of contaminated soil and concrete may be generated.

Ancillary equipment including all above ground pipingm, I.e. sludge pumps and piping etc. were removed and disposed of during the hazardous waste disposal activities outlined in § 4.0. The feed line from the laudry operation and discharge lines did not carry hazardous waste when the system was in operation and is not considered contaminated. The failure of the sludge pumping combined with continued use of the clarifier allowed liquid and solid waste containing low levels of contamination to collect within the clarifier structure and eventually reach hazardous levels.

7.0 CLOSURE PLAN

7.1 Closure Objectives / Cost Estimate

The objective of the closure activities is attainment of clean closure by demonstrating that the concrete structure, piping, and soil directly behind and beneath the clarifier are clean and abandonment of the unit in place by filling with Dyna-ash Flowable fill (or equivalent). If the concrete and surrounding soil are found to be contaminated above the closure performance standards, closure will be completed by demolition of the clarifier, excavation of its walls, and some of the surrounding soil. Within 60 days following completion of the closure activities, certification by a registered engineer will be submitted, in accordance with 40 CFR § 264.115. The closure process is not complete until VDEQ verifies and approves the closure certification.

The primary contact for activities related to the closure plan is:

Ajay Kapoor, P.E., General Engineer
District of Columbia Department of Corrections

8515 Silverbrook Road	Mailing Address:
P.O .Box 26	P.O. Box 25
Lorton, Virginia	Lorton, Virginia 22079
(T) 703-643-6701	
(F) 703-643-1108	

The Hazardous Waste Manager for closure activities is:

Charles Kirk
AAS Environmental, Inc.
643 Loftstrand Lane
Rockville, MD 20850-1389
(T) 301-294-3211
(F) 301-294-3212

A scope of work for closure activities will be developed and an appropriately licensed and experienced firm will be contracted for this work.

The closure, contingent closure, and post-closure cost (third party) estimates for the potentially contaminated area included in Appendix H shall be kept on file at DC DOC. The post-closure cost estimates will be updated annually, if closure is not achieved in accordance with this plan, using the Annual Implicit Price Deflator for Gross National Product. The annual adjusted cost estimates will be retained at DC DOC and submitted to VDEQ during the final contingent closure (post-closure) period for all regulated units.

DC DOC is required to submit financial assurance for the Ink Pit per Appendix B, Condition 3.e. of the Consent Order, dated July 8, 1999. The Consent Order requires DC DOC, within 30 days of submitting a closure plan for the ink pit, submit to DEQ evidence of financial assurance for the Ink Pit in accordance with 40 CFR §§ 264.143, 264.144, and 264.145.

Effective February 1999, the Virginia Hazardous Waste Management Regulation, 9 VAC 20-60-

12, *et. seq.*, was amended to incorporate by reference the federal regulations covering hazardous waste treatment, storage, and disposal facilities. The financial assurance requirements for permitted facilities are found in 40 CFR § 264. DC DOC, pursuant to the Consent Order dated July 8, 1999, will submit evidence of financial assurance for the Wastewater Clarifier. Financial Assurance may be demonstrated by one or a combination of the financial responsibility mechanisms listed on the following chart.

Type of Mechanism	Requirements and Required Language for Mechanism
Trust Agreement	40 CFR §§ 264.143/144 & 264.151
Surety Bond/Standby Trust Agreement	40 CFR §§ 264.143/144 & 264.151
Letter of Credit/Standby Trust Agreement	40 CFR §§ 264.143/144 & 264.151
Insurance Policy/Certificate of Insurance	40 CFR §§ 264.143/144 & 264.151

Regardless of the type of mechanism selected, the wording of the mechanism must be identical to the wording provided in 40 CFR § 264.151; however "Regional Administrator" and "U.S. Environmental Protection Agency" must be replaced with "Director" and "Department of Environmental Quality," respectively, wherever they appear.

The financial assurance mechanism must be submitted as a signed, original document to the Virginia Department of Environmental Quality, 629 East Main Street, Richmond, Virginia 23219. The face amount of the financial assurance mechanism must equal the current closure cost estimate for the Ink Pit.

7.2 Decontamination

Objectives of decontamination are:

1. To prevent the spread of contamination on and off site,
2. To protect human health from exposure to contaminants, and
3. To prevent cross-contamination of soil and water samples collected for laboratory analysis.

7.2.1 Decontamination Zone

A decontamination zone will be established prior to initiation of closure procedures. The decontamination zone will be bermed and graded as needed so that decontamination rinse water (rinsate) flows to one central location, and will be underlain by a plastic liner with a minimum thickness of 10 mils to prevent the loss of decontamination fluids. All water used for decontamination purposes will be vacuumed via wet/dry vacuum and transferred into Department of Transportation (DOT) approved 55 gallon drums. Decontamination water may not be allowed to pond. To control access to the work zone, the decontamination zone will be divided into two areas. Area 1 will be used to decontaminate personnel and small sampling equipment. Area 2 will be used to decontaminate heavy equipment. The locations of the decontamination zones are shown in Figure 7.

All personnel and equipment entering the work zone will enter through the decontamination zone. Prior to entering, personnel will don appropriate personnel protection equipment per the OSHA required site safety plan.

7.2.2 Sampling Equipment Decontamination

Area 1 will be used to decontaminate personnel and small sampling equipment. This decontamination area will be set-up for all non-disposable sampling equipment and personnel decontamination, as needed per the OSHA requirements. The area will be set-up on plastic or in tubs. The decontamination waters shall drain to a container or be continuously pumped to a container during decontamination so that no decontamination waters are allowed to accumulate.

Personnel and sampling equipment shall be decontaminated, as follows: (note, all decontamination will occur in the sampling equipment decontamination area and waste generated will be properly managed in accordance with all applicable state and federal hazardous and solid waste regulations).

1. Remove loose material from equipment being decontaminated by brushing or scraping. The material removed will be properly containerized and disposed of in accordance with all applicable state and federal hazardous and solid waste regulations.
2. The equipment will then be washed with a non-phosphate detergent. All decontamination washwaters will be continuously collected and containerized for proper disposal in accordance with Step 6, below.
3. Rinse with tap water then rinse with distilled or deionized water. These decontamination rinsewaters will also be continuously collected and containerized for proper disposal in accordance with Step 6, below.
4. If metal contamination is present, a rinse with 10% nitric acid will be used. This acid rinse will be followed by another distilled or deionize water rinse. These rinsewaters shall be collected and containerized for proper disposal in accordance with Step 6, below.
5. Equipment will be allowed to air dry completely then rinsed again with distilled or deionized water.
6. All washwaters and rinsewaters generated during decontamination procedures will be properly managed. These liquids shall be collected and containerized. A determination of the waste classification shall be made by the generator in accordance with the regulatory requirements. If liquids contain a listed waste, or they exhibit any of the characteristics of hazardous waste in accordance with 40 CFR § 261, accumulation will be in compliance with the generator requirements of 40 CFR § 262. On-site accumulation will not be greater than 90 days. This 90-day period will begin once the wastes are generated. If the liquids are deemed hazardous waste, management, transportation, and disposal per the

requirements of 40 CFR § 262 by reference (Generator Requirements) will be followed. If not hazardous waste, management by a publicly-owned-treatment-works, with prior permission, or in accordance with the solid waste regulations, 9 VAC 20-80-10 et seq., will be required.

Disposable equipment will be properly containerized and disposed in accordance with all applicable state and federal hazardous and solid waste management regulations.

7.2.3 Heavy Equipment Decontamination

Area 2 will be used to decontaminate heavy equipment with high-pressure steam/water cleaning until all residuals appear to have been removed. This process will occur over a synthetic liner, surrounded by a berm so that no rinsate water will spill. Decontamination/Rinse waters will be pumped continuously and not allowed to pond. Area 2 will also be underlain by lapped 4 foot by 8 foot boards (i.e., OSB board), which will be utilized as a driveway for excavation equipment. All heavy equipment will be decontaminated, including its wheels/tracks, undercarriage, frames, booms, etc., before it leaves the site.

All waste produced during the decontamination process will be collected on-site and disposed of in accordance with all appropriate state and federal hazardous and/or solid waste management regulations. Hazardous wastes generated by closure activities will be transported to a licensed hazardous waste treatment/storage/disposal facility within 90 days of generation.

7.2.4 Management of Decontamination Fluids and Residuals

The following waste streams may be generated during closure activities:

1. Rinsate water from the Area 1 and Area 2 decontamination sites.
2. Disposable sampling and personnel protective equipment (Tyvek suits, bootie covers, nitrile gloves, etc.).
3. Disposable decontamination zone equipment (liner, OSB).
4. Excavated soils and concrete clarifier structure.
5. Wash water from clarifier cleaning.

All wastes generated during closure will be managed in accordance with applicable state and federal regulations. Waste streams will be characterized prior to disposal. If analytical results indicate that a waste is hazardous, then that waste stream will be labeled and handled as hazardous waste in accordance with 40 CFR § 262.

If the waste stream is determined to be non-hazardous, then it will be handled as a solid waste in accordance with Virginia's Solid Waste Management Regulations (VSWMR). Liquid waste that is determined to be non-hazardous may be discharged for treatment to the facility sewage treatment plant provided that the analytical results are within the treatment system's acceptance limits.

7.3 Closure Procedures

7.3.1 Site Survey

A professional land surveyor will perform a survey of the immediate area around the wastewater clarifier, in accordance with 40 CFR § 264.1109. Significant landmarks such as the following, will be noted on the survey,

- All building corners, fence lines and pavement areas.
- All structures associated with the operation of the clarifier.
- All well locations installed as a part of this study. Care will be taken to engrave a permanent measuring mark on the top of each well casing for the purpose of prescribing a permanent elevation measuring point for that well.
- Any significant utility lines (i.e., sanitary or storm sewer lines).
- Any significant hydrogeological feature within the survey boundary (i.e., perennial or permanent streams).

7.3.2 Site Mobilization and Setup

Upon notification of approval of this closure plan, bid packages will be prepared and subcontractors will be selected. The required notifications of the start of closure activities will be made to the VDEQ and appropriate local authorities, as required. The work zone will be posted to prevent unauthorized entry during closure activities. The work area is secured by an 8 ft chain link fence with lockable gate. Prior to initiation of closure activities, the decontamination zone will be set up.

7.3.3 Concrete Hazard Determination

As part of the initial hazardous waste removal activities described in § 4.0, the clarifier interior was decontaminated of dirt, sludge, debris, etc in September 1999. Currently the clarifier contains approximately 10, 000 gallons of water that resulted from a broken water line next to the unit. The DC DOC will sample water currently in the clarifier. Analytical results from the water sample will be compared with the analytical results from background water samples or approved risk values. If no contamination above the closure performance standards is detected, the concrete will be considered clean.

If the analytical results from the sample of water currently in the clarifier indicate are above the closure performance standards, as a second alternative to additional concrete decontamination, the DC DOC may elect remove the water currently within the clarifier and to test at least eight random concrete sites for contamination to create sufficient statistical power to determine the level of contamination. If the wipe tests indicate the concrete is not contaminated above the closure performance standards, the concrete will be considered clean and decontamination of the clarifier will be complete. If the wipe tests indicate contamination, then the concrete must be cleaned to background and/or risk performance standards in order to abandon the concrete in place. The cleaning methodology may be hydraulic or mechanical.

Prior to additional decontamination and after removal of the water currently in the clarifier, an independent Virginia registered professional engineer will thoroughly inspect the containment surface for cracks, gaps or other migration pathways through which contamination may have potentially migrated to the soils underneath and adjacent to the concrete structure. All cracks in the containment will be identified and included on the site survey for determining sampling locations in underlying soil. If additional decontamination of the concrete surface is required, the cracks/gaps will be filled with a sealing material that will not leak, such as an epoxy sealant prior to cleaning.

7.3.3.1 Concrete Decontamination - Mechanical Concrete Cleaning

DOC may elect to physically treat the surface, per 40 CFR § 268.45, in order to remove the residual contamination. In accordance with 40 CFR § 268.45, a treatment standard for hazardous debris shall be selected for the waste-specific contaminants and media. The physical extraction methods applicable to concrete are:

- Abrasive Blasting,
- Scarification, Grinding, and Planing,
- Spalling,
- Vibratory Finishing, or
- High Pressure Steam and Water Sprays.

Applying these methods to concrete requires meeting a performance standard as specified in 40 CFR § 268.45, Table 1, including removal of 0.6 cm of the surface layer and treatment to a clean debris surface[1]. Treatment in this manner will satisfy the closure performance standards.

The physical treatment method selected shall be performed in accordance with the requirements of 40 CFR § 268.45. After surface removal, an independent registered professional engineer will reinspect the concrete for cracks and gaps to insure the requirements of 40 CFR § 268.45 have been met. If a clean debris surface per 40 CFR § 268.45 is not verified, then the closure performance standards will not have been achieved and the clarifier will be decontaminated per the following section, § 7.3.3.2, or removed and disposed of per 40 CFR § 264.228(a)(1).

If the concrete meets the clean debris surface requirements, it may be left in place after the decontamination effort is approved by DEQ. An independent professional engineer will attest to the absence of migration pathways, the removal of visible stains and the removal of the surficial concrete to at least a depth of 0.6 centimeters. The certification will be submitted to VDEQ for approval.

[1] Clean debris surface means the surface, when viewed without magnification, shall be free of all visible contaminated soil and hazardous waste except that residual staining from soil and waste consisting of light shadows, slight streaks, or minor discolorations, and soil and waste in cracks, crevices, and pits may be present provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to no more than 5% of each square inch of surface area.

7.3.3.2 Concrete Decontamination - Hydraulic Concrete Cleaning

As an alternative to mechanical concrete cleaning described in § 7.3.3.1, DOC may elect decontaminate the clarifier with high-pressure water cleaning and rinsing with water and a mild alkaline soap cleaning solution (such as Alconox).

The concrete structure is cleaned, working from the walls down to the floors. Then the main floor will be cleaned, working from the walls down to the floor. The retention areas will be cleaned last, working from the highest elevations (i.e., curbing) to the lowest elevations (i.e., lowest point of the floor).

Either the concrete will be swabbed to determine contamination (see Appendix I for further delineation) or wash water will collected. Wash water will be removed from the low areas manually or using an auxiliary pumping system that will pump the wash water into DOT-approved containers. Any residual liquid will be removed with absorbent material, which will be placed in a separate container.

After the area has been thoroughly washed and rinsed, the washing and rinsing operations will be repeated two additional times. The area will then be rinsed one additional time with the rinse solution. After the area has been rinsed for the final time, a sample of the final rinse solution will be collected from the bottom of the clarifier.

Analytical results from the final rinse water sample will be compared with the analytical results from background water samples collected or approved risk values. If no contamination above the closure performance standards is detected, decontamination of the clarifier will be complete.

If contamination is detected above the closure performance standards, the affected structures or areas will be further decontaminated per the above procedures and another final rinseate sample will be collected. This sample will be analyzed for those contstituents that did not meet the closure performance standards.

Following repeated high-pressure washing for decontamination, if confirmatory sampling and analysis of the final rinseate indicates that any of the areas are still contaminated above the closure performance standards, the affected area(s) may require decontamination by a secondary decontamination method. The method chosen will be based on a thorough evaluation of available methods and contaminants present. Decontamination activities will be repeated until no contamination above the closure performance standards is detected. If the contamination cannot be removed, the concrete will be demolished and removed for disposal in accordance with the procedures outlined in § 7.3.4.

As an alternative to further decontamination procedures, at any time in the closure procedures, the facility may elect to demolish any or all portions of the clarifier and manage them as hazardous waste (if necessary) prior to transporting off-site. Should this alternative be selected, any sampling and analysis of underlying soils which are prescribed by this plan will still be carried out. Prior to removing the structure for disposal, the location of any cracks/gaps previously identified will be marked for sampling of the underlying soil.

7.3.4 Soil and Concrete Removal

Should it be determined that removal of soils and concrete is required to achieve clean closure, demolition and disposal of the concrete structure and the underlying/adjacent soils will be performed in accordance with the following procedures:

1. The DOC will procure an excavation contractor with appropriate health and safety training to demolish and dispose of the concrete structure as detailed in §7.8.
2. The decontamination zone and work zone will be cordoned off and set up per the procedures in Section 7 of this plan.
3. The contractor will demolish and excavate the affected concrete and soils. The decontamination procedures described in Section 7 of this plan will be utilized during all excavation activities.

7.4 Sampling Procedures

7.4.1 Background Water and Soil Sampling

Achievement of the closure decontamination standards may be demonstrated through the use a statistical comparison to the hazardous constituent concentrations in rinseate or soil samples to those of uncontaminated background samples.

The water source used for cleaning and decontamination activities will be sampled and analyzed to determine the concentrations of the hazardous constituents of concern (HCOC). Prior to collecting the samples, the water source will be allowed to run for 5 to 10 minutes to flush the line so that representative water samples can be obtained. Eight grab samples will be collected from the water supply outlet used as the water source for initial cleaning and decontamination. A sufficient number of rinseate samples will be analyzed to satisfy the criteria of the statistical method(s) utilized to determine the presence of contamination. The samples will be evenly spaced over the time of decontamination activities.

Background soil samples will be obtained from an area unaffected by hazardous waste management activities and from a soil of similar geology and soil type as the unit subsoil. Eight background soil samples will be collected from a depth of six inches to twenty-two feet below the surface.

All samples will be analyzed for all hazardous constituents of concern (HCOC) specified in Appendix D according to procedures outlined in Section 7.5. The analytical data will be used to calculate the statistical parameters for each analytical parameter.

7.4.2 Soil Sampling

Soil samples will be collected using EPA standard operating procedures. The collection of soil samples for volatile organic compound and heavy metal analyses will follow EPA Update III to SW846 (June 1997). Sampling and analysis procedures will follow EPA Method 5035 using the EnCore Sampler to minimize the loss of volatile compounds.

The soil probe will be decontaminated between sampling to avoid cross contamination. Cleaning will be performed in accordance with the decontamination procedures specified in § 7.2.2. of this report.

7.4.2.1 Concrete Abandonment Soil Sampling

If the concrete meets the clean debris surface requirements and can be left in place, soil samples will be collected through the concrete walls of the structure in order to determine the levels of HCOC within the soil directly behind/beneath the concrete. Soil samples will be will be collected from a minimum of nine (9) locations within the clarifier. One sample will be colleted from each of the four (4) vertical wall sections, one sample will be colleted from each of the four (4) sloped wall sections and one sample will be collected through the floor of the clarifier. Where possible, the sample collected from each wall and the floor will be collected through the largest crack/defect identified on the wall section or floor. If no cracks/defects are present on a particular wall or the floor, the sample will be collected through the center of the wall or floor. Diagrams of the clarifier are shown in Figures 4, 5 and 6. At each sampling point the concrete slab will be core drilled and soil samples will be removed taking care to avoid mixing of the soil. Soil samples will be collected from 0-12 inches and 12–24 inches behind/below the concrete slab and gravel sub-base. Soil samples will be analyzed for HCOC listed in Appendix D according to procedures outlined in Section 7.5.

7.4.2.2 Demolition and Disposal Soil Sampling

If it is determined that the concrete does not meet the clean debris surface requirements and/or the soil located directly behind/beneath the concrete can not be clean closed in place, the concrete will be demolished and removed for disposal along with contaminated soil. Once the concrete is removed, if the soil sampling conducted as part of the concrete abandonment sampling fails to determine the depth of contaminated soil, soil samples of the area around the clarifier will be obtained. Care will be taken to retrieve samples in as undisturbed state as possible. When it becomes necessary to collect samples from the excavation, properly trained and equipped personnel will enter the excavation to collect discreet samples. Care will be taken to note the precise location from which the sample was procured. Each sample location will become part of a three-dimensional grid coordinate system established before the start of the job and tied into the site survey.

The number of samples collected from the excavation will depend on the quantity of data collected during the concrete abandonment soil sampling described in the previous section. At a minimum, 2 samples from each of the four (4) sidewalls of the excavation, and two (2) samples from the floor of the excavation will be collected (including samples collected during the concrete abandonment soil sampling). If cracks or gaps in the concrete containment surface (i.e.,floor and walls) were identified during the initial inspection, at least one soil sample will be obtained from beneath the location of each crack or gap. Soil samples will be obtained from the following intervals: 0-12 inches, and 12-24 inches below the surface of the excavation. Soil samples will be analyzed for HCOC listed in Appendix D according to procedures outlined in Section 7.5.

All holes made in the clarifier structure for the purpose of soil sampling will be filled with a hydraulic cement plug a minimum of 3 inches thick.

7.4.3 Classification of Soils

The following information will be obtained and logged during the sampling and/or excavation process (when appropriate):

Date of Sample Collection or Excavation
Soil/Rock Type
Color and Stain
Gross Petrology
Moisture Content
Degree of Weathering
Presence of Carbonate
Bedding
Each Water Bearing Zone
Organic Content
Name of Geologist Performing Logging
Depth to Saturation

The soils will be characterized using the USC Classification System.

7.5 Analytical Procedures

All samples collected pursuant to this closure plan will be analyzed for all hazardous constituents of concern (HCOC) specified in Appendix D including Volatile Organic Compounds by gas chromatograph/mass spectrometer (GC/MS), EPA Method 8260, for Semi-volatile Organic Compounds, Method 8270, for Chlorinated Pesticides and PCBs by EPA Method 8081. All analytical methods are in accordance with SW-846, Test Methods for Evaluating Solid Waste, 3rd Edition, 1986, EPA as updated. The HCOC list in Appendix D contains the constituent, the appropriate analytical methods and practical quantitation limits (PQL). Detection limits will be set at Practical Quantitation Limits (PQLs).

7.5.1 Lab Selection

The laboratory performing sample analysis is a laboratory regularly engaged in performing hazardous waste profile analyses and will use only approved EPA methods for the type of analysis required. Furthermore, the laboratory has a comprehensive Quality Assurance / Quality Control Program in place. The following laboratory has been selected to perform the analyses required under the closure plan:

Phase Separation Science, Inc.
6630 Baltimore National Pike
Route 40 West
Baltimore, MD 21228
Phone: (410) 747-8770 or (800) 932-9047
Fax: (410) 788-8723

www.phaseonline.com

7.5.2 Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) samples will be collected as a part of all sampling events. QA/QC samples will include equipment rinsate, duplicate soil samples, and duplicate groundwater samples. One QA/QC sample will be collected for every ten samples collected for laboratory analysis. Passing laboratory grade water through the sample collection equipment and collecting the water for analysis will collect equipment rinsate blanks. Duplicate groundwater samples will be labeled with a "D" following the sample number. The QA/QC samples will be handled the same as all other environmental samples. Quality assurance/quality control samples will be stored in clean sample containers. Each sample will be labeled and placed in a clean ice chest with enough ice to keep the sample cool until delivery to the laboratory. All samples will be documented on a laboratory chain of custody.

7.5.3 Chain-of-Custody Control

A chain-of-custody form will be completed for each set of samples collected. The form is maintained as a record of sample collection, transfer, and receipt by the laboratory. Custody of samples will be maintained and documented from the time of sample collection to the completion of analysis. The laboratory conducting the sample analysis will provide chain-of-custody documentation.

7.5.4 Sample Labeling

All sample labeling will be done in the field with indelible/waterproof ink. Any error will be crossed out with a single line, dated and initialed. Each sample container will be labeled with the following information:

- Sample identification number
- Sample location with grid coordinates tied to established survey location. The sample location will have x-y-z coordinates denoting plan locations and depth.
- Date of collection
- Type of preservation
- Name or initials of personnel collecting the samples
- Analysis requester
- Any other information pertinent to the sample

7.5.5 Data Review

The laboratory will be required to submit the final analytical data along with the results of its internal QA/QC procedures. A senior staff member at AAS Environmental, Inc. will review the laboratory data and the QA/QC procedures to ascertain that any measured variability falls within explainable limits. All laboratory results and QA/QC data will be submitted in the report to the DEQ.

7.6 Data Presentation

The Closure Report will be signed and certified by a Virginia professional engineer and owner/operator and will be submitted to the DEQ via registered mail, or hand delivered, within 60 days of the completion of closure activities. The Closure Report will include a summary of the closure activities that took place, QA/QC results associated with the sampling and analytical procedures utilized during the closure activities, and results of statistical and/or heath-based risk assessment.

7.6.1 Statistical Analysis

A statistical analysis of the compliance analytical data for each closure analyte from each stage is raised due to matrix interference and/or if the compliance samples for that analyte contain detectable concentrations of the closure analyte. The statistical comparisons will satisfy the following performance standards:

- The significance level will be no less than 5% throughout the statistical evaluations.
- The sampling results will satisfy the assumptions associated with the selected statistical method including the minimum number of background/compliance samples and the distribution of data points.
- A statistical method will be proposed for use in evaluating the closure and the applicability of the selected method that will be demonstrated to the VDEQ. If the statistical comparisons indicate that there is no significant difference between the background and/or risk based sampling results, the compliance sampling results are deemed to pass the background and/or statistical comparison, and the decontamination/closure is deemed to be adequate.

7.6.2 Health Based Standards

If the closure samples contain statistically significant concentrations of the targeted analytes, as compared to background samples, the data will be compared to health-based standards. The health-based standards will be developed in accordance with the VDEQ document titled "Guidance for Development of Health-Based Cleanup Goals Using Decision Tree/REAMS Program prepared by Old Dominion University and the approved closure plan. The protocol for developing health-based standards is included as Appendix B.

The risk assessment will contain the following sections:

- Site Evaluation
- Development of a site conceptual model
- Identification of contaminant of concern Identification of media and exposure pathways
- Toxicity assessment
- Calculation of the contaminant concentration at the point of exposure
- Summary of identified health risks

The exposure concentrations will be developed in accordance with the most current EPA recommendations at the time of the assessment. The risk goals will be a total cumulative hazard index of 1.0 and a total cumulative carcinogenic risk of 1×10^{-4} for multiple carcinogenic compounds. The target risk for a single carcinogenic compound will be 1×10^{-6}. The calculated risk based standards will be subject to VDEQ verification and approval.

7.7 Closure Performance Standards

The closure performance standards for the wastewater clarifier are the removal of the constituents listed in Appendix D to below detectable concentrations, background concentrations, or VDEQ approved health-based standards. The following performance standards will be utilized to determine the final closure status of the clarifier.

7.7.1 Soil Clean Closure Performance Standards

The unit's soil will be considered clean-closed, or closed with respect to health-based standards, requiring no further soil closure activities if one of the following conditions is met:

1. Detectable concentrations of the closure constituents are not present in the closure soil samples (providing detection limits are not raised due to matrix interference), or
2. Detected concentrations of the closure constituents in the closure soil samples are not present in statistically significant concentrations when compared to background samples, or,
3. Detected concentrations of the closure constituents in the closure soil samples are at or below the VDEQ approved health-based standards.

If performance standards 1, 2, or 3 are achieved, the unit's soil will be considered to be clean closed. If performance standard 3 is achieved, the unit's soil will be considered to have been clean closed with respect to health-based concentrations. If the soil standards cannot be achieved using the methodology presented in Section 7.7.4, the contingent closure and post-closure plans will be followed.

7.7.2 Concrete Clean Closure Performance Standards

The unit's concrete will be considered clean-closed, or closed with respect to health-based standards, and will be left in place if the soil located directly behind and beneath the concrete can be clean closed as described in Section 7.7.1 and the analytical results from the final rinse water or concrete surface samples generated during decontamination of the unit meet the following conditions:

1. Detectable concentrations of the closure constituents are not present in the concrete decontamination rinsate samples (providing detection limits are not raised due to matrix interference), or
2. Detected concentrations of the closure constituents in the concrete decontamination

rinsate samples are not present in statistically significant concentrations when compared to background samples, or
3. Detected concentrations of the closure constituents in the concrete decontamination rinsate samples are at or below the VDEQ approved health-based standards, or

If performance standards 1, 2, or 3 are achieved, the unit's concrete will be considered to be clean closed. If performance standard 3 is achieved, the unit's concrete will be considered to have been clean closed with respect to health-based concentrations. If the concrete closure standards cannot be achieved using the methodology presented in Section 7.3.3 and/or the soil located directly behind and beneath the concrete can not be clean closed in place as described in Section 7.7.1 the concrete will be demolished and removed following procedures outlined in Section 7.3.4 or the procedures outlined in the Contingent Closure Plan and Post-Closure Plans will be implemented.

7.7.3 Groundwater Clean Closure Performance Standards

The procedures for groundwater clean closure and detection monitoring have been submitted under separate cover (i.e., GMP).

7.8 Clarifier Closure

Upon determination that the clarifier and surrounding soils are not contaminated by hazardous constituents following the procedures outlined in section 7.7, the clarifier will be closed. Details regarding the closure of the clarifier are as follows:

7.8.1 Abandonment in Place

If the concrete unit and the surrounding soil located directly behind and beneath the concrete can be clean closed according to guidelines presented in Sections 7.7.1 and 7.7.2, application will be made to the VDEQ to abandon the unit and soils in place. The application will include a preliminary Closure Report. The Closure Report will be signed and certified by a professional engineer licensed in the Commonwealth of Virginia and owner/operator and will be submitted to the DEQ via registered mail, or hand delivered, within 60 days of the completion of initial closure activities as outlined in Section 7.6. The Closure Report will include a summary of the closure activities that took place, QA/QC results associated with the sampling and analytical procedures utilized during the closure activities, and results of statistical and/or heath-based risk assessment.

Once approval to abandon the unit is received from the VDEQ, The Hazardous Waste Manager will assist the DOC with procurement of a contractor with appropriate health and safety training to abandon the unit in place by filling with Dyna-ash Flowable fill or equivalent. The unit will then be capped with a concrete pad mounded in the center to allow rainwater to drain. In accordance with 40 CFR § 264.228(a)(2)(iii), the surface impoundment cover shall be designed and constructed to:

- Provide long-term minimization of the migration of liquids through the closed impoundment;
- Function with minimum maintenance;
- Promote drainage and minimize erosion or abrasion of the final cover;
- Accommodate settling and subsidence so that the cover's integrity is maintained; and
- Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

A final closure report amendment will be submitted to the VDEQ documenting the filling of the unit. The unit will then be considered closed with no further action required, however, it is recognized that the closure process is not complete until VDEQ verifies and approves the closure certification.

7.8.2 Demolition and Disposal

If the concrete closure standards cannot be achieved using the methodology presented in Section 7.3.3 and/or the soil located directly behind and beneath the concrete can not be clean closed in place as described in Section 7.7.1 the concrete will be demolished and removed along with the surrounding soil (if necessary) following procedures outlined in Section 7.3.4.

Once the concrete is removed and the surrounding soil removed such that remaining soil meets the clean closure requirements described in Section 7.7.1, the resulting pit will then be back filled with clean fill.

A Closure Report, signed and certified by a Virginia professional engineer and owner/operator, will be submitted to the VDEQ via registered mail, or hand delivered, within 60 days of the completion of closure activities as outlined in Section 7.6. The Closure Report will include a summary of the closure activities that took place, QA/QC results associated with the sampling and analytical procedures utilized during the closure activities, and results of statistical and/or heath-based risk assessment. The unit will then be considered closed with no further action required, however, it is recognized that the closure process is not complete until VDEQ verified and approves the closure certification.

7.9 Schedule for Closure

The closure of the clarifier will be initiated in accordance with the approved closure schedule presented as Appendix F. If clean closure cannot be achieved within the schedule presented, an extension of closure time will be requested at least 30 days prior to the original closure deadline, as described in 40 CFR § 265.113(b).

8.0 HEALTH AND SAFETY PLAN FOR CLOSURE ACTIVITIES

A Health and Safety Plan for the closure activities will be developed in accordance with 29 CFR 1910 and implemented prior to conducting any closure activities. All personnel working on the closure of the site will be required to review the plan. Personnel will then be required to sign the plan indicating they have read and understood the plan. The Health and Safety Plan will be available on site at all time when closure related activities are taking place.

9.0 CONTINGENT CLOSURE PLAN

It is the intent of Lorton to achieve clean or risk-based closure of the soils. The contingent closure plan is provided in accordance with 40 CFR §§ 264.113(e) and 264.228(c)(1). In the event that the extent of soils contamination makes it infeasible to remove all contaminated soils, the VDEQ will be notified and the contingent closure plan, which stipulates the unit be closed as a landfill in accordance with the requirements of the 40 CFR §§ 264.117 through 264.120, will be immediately implemented. Additionally, closure activities specified in this plan will comply with applicable sections of the OSHA Hazardous Waste Operations and Emergency Response requirements 29 CFR 1910.120 (i.e., health and safety training of workers, safety requirements at RCRA sites, etc.).

It is possible that excavation of the clarifier and of the surrounding soil will not remove all contamination. Three contingencies may arise:

- It may not be feasible to remove some part of the concrete or other fragment of the clarifier.
- Levels of contaminants in the soil in the side or floor of the excavation may, upon analysis, prove to be above both the background level and the health-based threshold.
- Analyses of groundwater from the monitoring wells may demonstrate the presence of contaminants above acceptable limits.

9.1 Remaining Concrete

If fragments of concrete and/or other parts of the clarifier and associated equipment or piping cannot be removed; they will be left in place and the owner or operator shall comply with all post-closure requirements contained in 40 CFR §§ 264 through 264.120, including maintenance and monitoring throughout the post closure care period. The owner or operator must:

- Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events.
- Maintain and monitor the ground-water monitoring system and comply with all other applicable requirements of Subpart F of 40 CFR § 264.
- Prevent run-on and run-off from eroding or otherwise damaging the final cover.

9.2 Remaining Contaminated Soil

If soil samples taken from the walls or floor of the excavation, or from the down gradient monitoring wells, prove to be above both the background level and the health-based threshold for contaminants of concern, the soils will be left in place and the owner or operator shall comply with requirements stated in § 9.1 of this report.

9.3 Contaminated Groundwater

The owner or operator shall comply with the requirements groundwater monitoring plan approved by the Department on November 28, 2000.

9.4 Restrictions on Development and Use of Property

In order to prevent release of any residual subsurface contamination, use or development of the site and its immediate vicinity involving excavation or other disturbance of subsurface metals will be restricted. No use of the property will be permitted that interferes with the proper functioning of the groundwater monitoring wells. The low permeability cap at the surface of the site will be maintained intact to prevent infiltration of surface water. These restrictions will begin upon completion of closure and will continue for 30 years as specified in 40 CFR § 264.117(a), unless the length of time is determined otherwise by the DEQ. The restrictions on development and use will extend for 150 feet beyond the excavation.

9.5 Contingent Closure Activities

If the determination is made that clean or risk-based closure cannot be achieved and contaminated soil has been removed to a point that remains above the seasonal low water table elevation, the contingent closure and post closure plans must be implemented. Closure of the surface impoundment location will be conducted in accordance with EPA's guidance document entitled *"Requirements for Hazardous Waste Landfill Design, Construction, and Closure" (1989).* In accordance with 40 CFR § 264(b)(2), the DOC will maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events.

9.5.1 Specifications and Testing Requirements

All contingent closure activities will be conducted under the surveillance of an independent professional engineer (P.E.) registered in the Commonwealth of Virginia. Technicians and engineers performing field tests and surveillance will report observations, measurements and test results to the P.E. The P.E. will recommend acceptance or rejection of the work, as units, or as a whole. During closure, progress reports will be submitted to the VDEQ. Copies of all raw data, field logs, QA/QC methods, and analytical quality assurance/quality control (QA/QC) data shall be submitted to the VDEQ with the closure completion certifications required by this contingent closure.

Test method and frequency are shown on Table 4, 5, and 6. During the closure of the waste management unit, the contractor will observe all local and state ordinances regulating construction sites. At a minimum, the site procedures will include:

1. Maintain erosion and sediment control as required by the Virginia Erosion and Sediment Control laws.
2. Establish a security perimeter to prevent casual trespassing onto the site. At a minimum the security perimeter will consist of a temporary restraint such as a rope with warning signs around the work activity area.
3. If applicable, advise police, fire departments and utility companies of the site location, planned activities, logistical provisions, and size of work crew.

9.5.1.1 Backfill

The depression caused by excavation of the contaminated material below the liner will be backfilled with uncontaminated [defined as no statistically significant (using the Cochran's Approximation to the Fisher Student's t-Test) HCOC above performance standard levels] on-site or off-site native soils (sand) placed in 6 inch lifts and compacted to at least 90% of its maximum dry density and within 2 to 4 percent of the optimum moisture content (as determined in the Standard Proctor test in ASTM D698). The soil will be compacted with a vibratory sheepsfoot compactor or equivalent equipment. The compacted soil will be free of clods, rock, fractured stone, debris, cobbles, rubbish, roots, and other deleterious material. The area will be graded sufficiently for the establishment of contours for the cover. Tests at the frequencies indicated in Table 4 shall be made on-site during construction to ensure adequate construction methods. All test results will be submitted to the VDEQ with the closure completion certifications. A cover will be placed over the site and extend at least 5 feet beyond the contaminated area surrounding previous waste excavated soils and/or surface impoundment location.

TABLE 1

TESTING	TEST METHOD	TESTING FREQUENCY
Removal of unsuitable materials (roots, stones larger than 2 inches)	Observation	Continuous
Slope, elevation	Surveying	After settlement
Soil Type (SC, SM, SP, SW)	ASTM D2487 or ASTM D2488	1/acre/lift
Density	ASTM D2922 or ASTM D2937	5/acre/lift
Density	ASTM D1556 or ASTM D2167	1/acre/lift
Moisture Content	ASTM D3017 or ASTM D4643	5/acre/lift
Moisture Content	ASTM D2216	1/acre/lift
Moisture-density relationship	ASTM D698	5/acre/lift
Grain Size	ASTM 422	1/acre/lift
Loose Lift Thickness	Shovel	Continuous
Final Lift Thickness	Survey	Each lift
Number of Passes	Visual	1/acre/lift
Construction Observation	Visual	Continuous

9.5.1.2 Landfill Cover

EPA's Recommended Final Cover: The facility shall construct a landfill in accordance with EPA's recommended cover design found in the EPA guidance document entitled *"Requirements for Hazardous Waste Landfill Design, Construction, and Closure" (1989)*. In accordance with 40 CFR § 264(b)(2), the owner must maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events. The document specifically recommends a standard final cover of 2 feet of topsoil 1-foot drainage layer, a 40 mil Flexible Membrane Liner (FML) with a 1-foot bedding layer as well as a 2-foot clay liner. The final cover will include the following elements from bottom to top:

Bottom: A compacted clay layer, consisting of two layers: (1) a bottom 2 foot clay layer lying wholly below the frost zone, with a minimum thickness of at least two feet and a maximum in-place saturated hydraulic conductivity of $1x10^{-7}$ cm/sec. (2) a 40 ml FML under a 12 inch sand bedding layer. A full discussion of the low-permeability clay layer and the FML are contained in Section 11.2.1.

Middle: A middle layer consisting of two components: (1) a soil drainage layer with a minimum thickness of one foot and a minimum hydraulic conductivity of $1x10^{-2}$ cm/sec that will minimize water infiltration into the low-permeability layer, and will have a final bottom slope of at least 3 percent after settlement and subsidence, and (2) a geosynthetic filter fabric to prevent fine particles from the final cover from clogging the drainage layer. A full discussion of the geosynthetic filter fabric and the drainage layer is contained in Section 11.2.2.

Top: The soil cover will be at least 24 inches thick. The effects of freezing on the liner are accounted for since the regional maximum frost penetration depth for the area is 12 inches. The soils selected will be able to support vegetation that will effectively minimize erosion. The topsoil will be either a loam or loamy sand or be of the following USCS soil types: GM, GC, SM, SC, ML or CL. The upper 6 inches of this layer will not be compacted in order to promote root development. The final slope will be 5 percent. A full discussion on the top layer is contained in Section 11.2.3.

All test results will be submitted to the VDEQ with the closure completion certifications. A final detailed report on the construction inspection program to monitor the closure of the surface impoundment shall include at a minimum: backfilling, consolidation, compaction, sampling, and testing of the backfill, drainage layer and clay cap; in place depth of the clay cap, drainage layer, and soil cover; establishment of vegetation; erosion control measures; and final site survey. The final report must be submitted within 60 days (with certification) after completion of closure.

9.5.1.3 Low Permeability Clay Layer

The clay materials will be capable of yielding a maximum in-place saturated hydraulic conductivity of 1×10^{-7} cm/sec. The proposed clay materials will be tested in the laboratory prior to installation to demonstrate the ability of the selected material to achieve the required criteria. The following tests will be conducted on the clay borrow source(s) prior to use:

1. Determine the plastic limit, liquid limit and plasticity index (Atterberg Limits) of the clay materials using ASTM method D4318.
2. Determine the moisture content of the clay materials using ASTM D2216.
3. Determine the density of the clay materials using ASTM D2922, ASTM D1556, ASTM D2167 or ASTM D2937.

4. Determine the moisture-density relationship of the clay materials using ASTM D698.

5. Classify the soil type (SC, CL, CH, ML, MH) using ASTM D2487 and ASTM D2488.

6 Determine the grain size distribution using ASTM D1140 and ASTM D422.

7. Determine the permeability of the clay materials using Method 9100 contained in "Test Methods for the Evaluation of Solid Waste Physical/Chemical Methods", (SW-846), 3rd Edition, 1986, as updated.

Testing data on the clay borrow source(s) including a moisture/density curve based upon test results for proposed borrow clay shall be submitted to the independent Virginia registered professional engineer for approval prior to construction of the clay layer in accordance with the closure schedule. Lorton shall also provide a moisture/density curve with the range of density and moisture content where permeability is acceptable. This region under the moisture/density curve would then become the acceptable specification for the material. If the results of any test indicate that the in-place hydraulic conductivity may not meet the 1×10^{-7} cm/sec standard, then the extent of the failure shall be determined by Lorton and appropriate adjustments shall be made to correct the failure.

The low-permeability layer must be entirely below the maximum depth of frost penetration estimated for the area in which Lorton is located. According to the Virginia Department of Conservation and Recreation's Division of Soil and Water Conservation, the maximum frost penetration depth is approximately 8 inches. Therefore, only the soil layer will be affected and the low permeability clay layer will be at least 48 inches below (24 inch top soil, 12 inch drainage layer and 12 inch FML sand bedding layer) the maximum frost depth.

The layer will be placed in 6" lifts and compacted to 95% of its maximum dry density and within 2 to 4 percent wet of the optimum moisture content as determined in the Standard Proctor test (ASTM Method D698). The clay will be compacted with a vibratory sheepsfoot compactor or equivalent equipment. The compacted soil will be free of clods, rock, fractured stone, debris, cobbles, rubbish, roots, and other deleterious material. When weather conditions are favorable, the clay surface will be sealed with a smooth drum vibratory roller to prevent desiccation or erosion. Tests at the frequencies indicated in Table 2 will be made on-site during construction to ensure adequate construction methods. Since the correlation between moisture-density and permeability will be established as above, test results falling within the region identified as above will be considered acceptable. Test results falling outside the region will be unacceptable and the cap will be removed and replaced. The final grade will be such that a slope of 3% to 5% will be maintained after allowance for settlement and subsidence. All test results will be submitted to the VDEQ with the closure completion certifications.

TABLE 2

TESTING	TEST METHOD	TESTING FREQUENCY
Soil Type (SC, CL, CH, ML, MH)	ASTM D2487 or ASTM D2488	1/acre/lift
Density	ASTM D2922 or ASTM D2937	5/acre/lift
Density	ASTM D1556 or ASTM D2167	1/acre/lift
Moisture Content	ASTM D3017 or ASTM D4643	5/acre/lift
Moisture Content	ASTM D2216	1/acre/lift
Moisture-density relationship	ASTM D698	5/acre/lift
Permeability	SW-846 9100	1/acre/lift
In-place Permeability (No greater than 1×10^{-7} cm/sec)	Sealed double-ring infiltrometer	1/acre/lift
Grain Size	ASTM D1140/ ASTM D422	1/acre/lift
Atterberg Limits	ASTM D4318	1/acre/lift
Loose Lift Thickness	Shovel	Continuous
Final Lift Thickness	Survey	Each lift
Number of Passes	Visual	1/acre/lift
Construction Oversight	Visual	Continuous

A synthetic liner system shall include a 40 ml flexible membrane liner constructed in panels large enough to eliminate the need for field seaming. The cap installer will be specialized in the installation of synthetic liners and caps. The following items will be documented by the installer and made available for viewing by VDEQ, including:

- Complete identification of, and material specifications for all components of the synthetic cap including resin type, physical properties, and other pertinent data.
- Documentation of factory seam tests.
- A detailed construction inspection program, with test procedures, which follows the criteria included in the QA/QC document to be developed if contingent closure is to be implemented.
- In addition, for the FML, the manufacturer will provide documentation of random sampling for uniformity, thickness (ASTM D 374), tensile properties (ASTM D 638), and tear resistance (ASTM D 1004).
- Where possible, the above items must be made available prior to the actual installation of the FML and the other cap components.
- The synthetic cap layout will be located where applied stresses are minimal and will take into consideration any expansion and contraction anticipated due to ambient temperature variations. Excessive slack will be avoided to minimize rippling of the liner during placement of the drainage layer and vegetative support soil. The liner will overlay at least 2 feet of clay having a maximum saturated hydraulic conductivity of 10^{-7} cm/sec.

9.5.1.4 Drainage Layer

Areas adjacent to surface impoundment will be graded to drain away from the site. Because the area will be the high feature in the immediate vicinity, the only water contacting the area of the excavated soils and/or surface impoundment will be rain falling directly onto it. Because of the soil physical characteristics, any storm water from other areas will tend to percolate down through the soil rather than drain in defined channels. Also, any swales graded in a attempt to provide run-off channels would rapidly be filled in by wind blown sand. Therefore, efforts will be concentrated on maintaining adequate drainage off the cover while run-on should not be a significant factor (See Table 3).

The clay cap will be overlaid with at least a 12" thick drainage layer (above the 12 inch sand FML bedding area) having a permeability not less than 1×10^{-2} cm/sec to minimize water infiltration into the clay layer.

Granular material will be no coarser than 3/8 inch, and classified as SP or GP using ASTM D2487 and ASTM D2488. The material will be smooth and rounded, will not contain any debris nor will it contain fines that might lessen permeability. The granular material shall be screened or washed prior to construction to remove fines which may promote clogging and shall be compacted to at least 90% of its maximum dry density as determined in the Modified Proctor Test (ASTM Method D-1557). Tests at the frequencies indicated in Table 6 will be made on-site during construction of the drainage layer to ensure adequate construction methods. Placement of the granular material will be observed by the independent professional engineer. The final slope on the bottom of the drainage layer will be sloped 3% to 5% after allowance for settlement and subsidence. All test results will be submitted to the VDEQ with the closure completion certifications.

To prevent clogging, the drainage layer will be overlaid with a synthetic geotextile fabric filter. The synthetic filter material shall be nonwoven, polypropylene mat with sufficient tensile strength and durability to withstand the applied force of the top soil layer for the duration of the closure and post-closure periods without breakdown or a reduction in its ability to perform as designed. The synthetic geotextile filter shall be installed and anchored in accordance with the manufacturer's specifications.

The drainage layer must slope to an exit drain which allows percolated water to be efficiently removed. The drainage layer and filter fabric layer will be designed to allow free drainage of infiltrating surface water to perforated drainage pipe. The perforated collection perimeter drains shall be embedded in larger diameter stone to prevent sand from clogging the drainage pipes. The drainage system shall be designed to accommodate a 25-year, 24-hour storm. Drainage structures, as needed, will be constructed to channel and redirect surface water away from the covered area.

9.5.2 Groundwater Monitoring

The groundwater monitoring for the surface impoundment will be performed in accordance with the groundwater monitoring plan approved by the Department on November 28, 2000.

9.5.3 Security

Lorton will prevent the unknowing entry, and minimize the possibility for the unauthorized entry, of persons or livestock onto the surface impoundment area by installation of a 5 foot high chain UNAUTHORIZED PERSONNEL KEEP OUT," shall be posted at each entrance to the surface impoundment area, and at other locations, in sufficient numbers to be seen from any approach to the surface impoundment area. The legend will be in English and in any other language predominant in the area surrounding the unit and shall be legible from a distance of at least 25 feet.

9.5.4 Contingent Closure Schedule

Lorton shall comply with the closure schedule as provided in Appendix F.

9.6 Certification

Final closure of the surface impoundment location will be supervised by an independent professional engineer registered in Virginia. Within 60 days of completion of closure, certification of closure in accordance with the approved plan and 40 CFR § 264.115. must be sent by registered mail to the Director of the VDEQ. The certification must be signed by the owner/operator and by an independent professional engineer registered in Virginia.

Within 60 days of completion of contingent closure as specified in Appendix F, Lorton will also submit a survey plat of the site to the local land recording authority and the Director of the VDEQ in accordance with 40 CFR § 264.117. This plat will indicate the location and dimensions of the closed area with respect to permanently surveyed benchmarks. This plat shall also contain a note, prominently displayed, which states the owner's or operator's obligation to restrict disturbance of the hazardous waste disposal unit in accordance with 40 CFR § 264.117.

10.0 POST CLOSURE PLAN

10.1 Introduction

The following is the post-closure plan for the surface impoundment location. This plan will become effective immediately upon completion of contingent closure activities. This plan will not be applicable if clean of risk-based closure of soils and groundwater is certified and accepted by the VDEQ. This plan will remain in effect until a post-closure permit is obtained for the surface impoundment. The post-closure permit application will be submitted within 180 days of (or with the) notification that clean or risk-based closure cannot be obtained.

10.2 Inspection and Maintenance

The site will be inspected on a weekly basis until vegetative cover is firmly established or for six months, whichever is longer. After the initial period, inspections will be performed monthly for the duration of the post-closure period. The final cover will be inspected for settling which would allow ponding of water, for animal vectors which may compromise the integrity of the cap, for erosion which could expose the cap, and for any other visible damage. Vegetation will be observed to check its adequacy and to prevent growth of trees and other vegetation with root systems which could damage the integrity of the cap or drainage system. Monitoring wells will be checked to ensure that caps, casings, seals, and locks have not been damaged or altered in any way which would allow contamination of the groundwater or the sample collection or might prevent sample collection. Permanent benchmarks will be inspected to ensure they have not been damaged or rendered unusable. Fencing and signs will be inspected to ensure they have not been damaged. These items are included in a post-closure inspection checklist (see Appendix G). Each site inspection will be documented on the inspection checklist to include all findings and any corrective actions required. The following office will be the point of contact for information regarding the site:

Ajay Kapoor, P.E., General Engineer
District of Columbia Department of Correction
8515 Silverbrook Road
Lorton, Virginia 22079
(T) 703-643-6701
(F) 703-6432-1108

Mailing Address:
District of Columbia, Department of Corrections
Office of Facilities Management
Attn: Ajay Kapoor
P.O. Box 25
Lorton, VA 22079

Maintenance activities as required will be performed following each inspection period. Any areas which have settled, resulting in a low area or have eroded due to surface run-off, will be filled to match surrounding grades and slopes, stabilized with erosion control matting, and planted with grasses to prevent further erosion. Special attention will be paid to these areas during subsequent inspection periods until the area has stabilized. Any area where grasses have died or thinned out will be replanted to maintain adequate protection from erosion. Where trees or other larger plants have been removed, any depressions left from their removal will be filled and replanted. Monitoring wells damaged from vandalism, equipment operations or other closure or contingent closure activities will receive immediate repairs and be resurveyed. If necessary, a new well will be installed to the same specifications used for the original wells. Should problems occur with any monitoring well, VDEQ will be notified immediately of the situation and advised of actions to be taken. Benchmarks that are damaged shall be reset as required to ensure their accuracy. Fencing and signs damaged from vandalism, equipment operations or other activities will be repaired immediately.

10.3 Groundwater Monitoring

The groundwater monitoring program will be performed in accordance with a groundwater monitoring plan approved by VDEQ. The groundwater monitoring program in accordance with the approved GMP will continue under the contingent closure/ post-closure plan until a post-closure permit is issued.

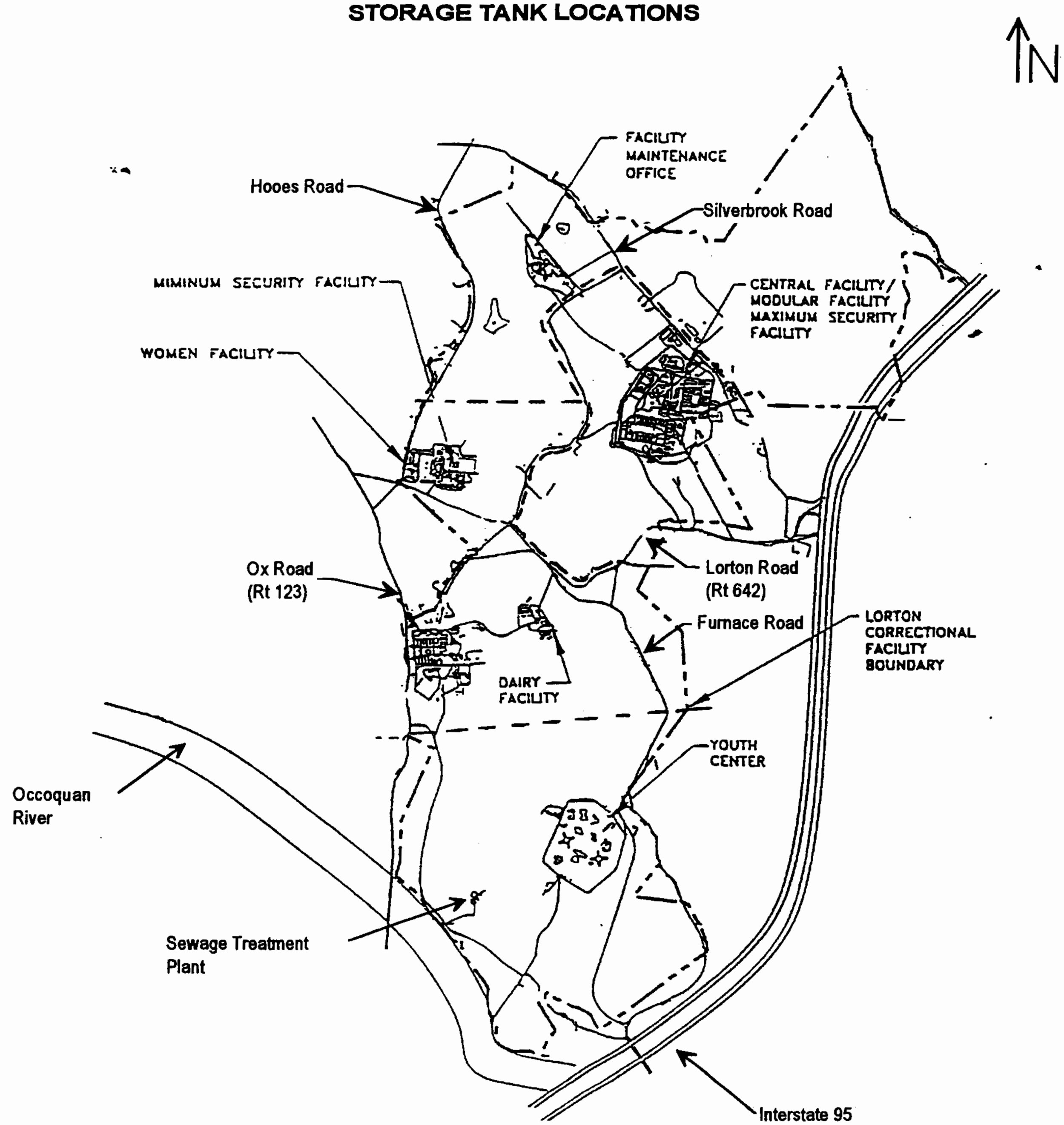
10.4 Post-closure Schedule

Post-closure will begin immediately upon completion of contigent closure activities and will continue for 30 years from the date that the post-closure plan is instituted unless reduced or extended by the Director of the VDEQ per 40 CFR § 264.117(2). Within 60 days of completion of the post-closure period, certification that the post-closure was performed in accordance with the post closure plan must be sent by registered mail to the Director of the VDEQ per 40 CFR § 264.119. The certification must be signed by the owner and operator and by an independent professional engineer registered in the Commonwealth of Virginia. The post-closure schedule is presented in Appendix G.

In addition, within the time frame established by Appendix F, a notation must be made in the property deed in accordance with 40 CFR § 264.119(b)(1). The notation must state that the land has been used to manage hazardous waste, it's future use is restricted, and that the survey plat has been filed with the local land recording authority and the Director of the VDEQ.

FIGURES

LORTON CORRECTIONAL FACILITIES
STORAGE TANK LOCATIONS



LORTON CORRECTIONAL FACILITIES
LORTON, VIRGINIA

Project Code: E-2937-012	AAS Environmental, Inc. Environmental Engineering Consultants
Figure # 1	